newTRENDs

Identifying New Societal Trends impacting future energy demand

Deliverable 2.1

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Executive summary

The newTRENDs project is developing the analytical basis for a "2050 Energy Efficiency Vision" taking into account New Societal Trends that may have a significant impact on energy demand in the European countries. The aim of this vision is to increase the qualitative and quantitative understanding of impacts of these New Societal Trends on energy consumption and to improve the modeling of energy demand, energy efficiency and policy instruments to increase the ability of policy makers to guide those trends in the light of the Paris Agreement and the long-term climate and energy targets of the European Union. Exploring the future impact of these New Societal Trends implies that not only techno-economic scenarios have to be investigated but also scenarios focusing on changes in life-style, the impact of a shared economy, etc. Additionally, the impacts of cross-sectoral changes are to be analyzed, as many Megatrends are expected to have an impact on the currently applied structure of the energy demand categories (i.e. industry, transport, buildings and services).

The goal of the newTRENDs project is to enhance existing energy demand models to the extent that they are able to model the influence of new social trends on energy demand, and hence to develop scenarios of their future development. The digitalization of the economy and private life (including new and smarter ways for private households to consume, produce and manage their own energy), investments in autonomous electric cars and other transport reforms, the circular economy, creation of a low-carbon industry, and the sharing economy, particularly in transport and the tertiary sector – these are examples of trends that are expected to have a great impact on increasing or reducing energy demand in the European Union in the coming years.

New Societal Trends are understood as societal developments arising from general Megatrends, which can have potentially large (increasing or decreasing) impacts on energy consumption as well as cross-sectoral demand shifts. Those New Societal Trends are not simply the extrapolation of already presently observed trends ("continuous or linear trends") but may take up speed when they are embraced by larger parts of the society ("disruptive or non-linear trends"). Trends that are potentially disruptive and might alter current sectoral dynamics include the following:

- transition of consumers to prosumagers,
- move towards a Circular Economy and a low-carbon industry,
- digitalization of the economy and of private lives,
- trends towards a shared economy.

This deliverable presents the process of developing, identifying and prioritizing the New Societal Trends that potentially have a major impact on the future energy demand. This research has been conducted in five steps:

1) 241 factors that might be relevant for future energy demand were identified and selected based on an analysis of previous foresight studies and long-term energy demand scenarios.
2) In two expert workshops, the factors were clustered into new societal trend candidates and their potential importance, and disruptiveness was assessed using the three-dimensional metrics (impact degree, impact

scale, impact direction). As a result, 20 new societal trend candidates (clusters of factors) were developed, and 10 of them were selected through expert voting as “priority” clusters.

3) In a third, internal workshop, the final list of 15 new societal trends was created, where the trends were classified into four categories: “Universal”, “Nice to have”, “Optional” and “Future research”.
4) The narratives for the resulting 15 major new societal trends were developed to describe the potential mechanisms of their impact and disruptiveness for future energy demand.
5) A network analysis of interrelationships between the new societal trends derived based on the expert discussion in the workshops to better understand how these interrelations should be reflected in the enhancement of the energy demand models.

The analysis has shown that the resulting new societal trends and their underlying factors have a controversial impact on future energy demand (simultaneously decreasing, increasing or shifting to other sectors) and are therefore crucial to be studied detail to assess their final contribution to the energy transition. The findings from this deliverable highlight the importance of taking additional matters, such as disruptiveness of trends, uncertainties related to trends, cross-impact and cross-sectoral analysis, as well as associated policy measures, into account when modeling future energy demand. These additional matters inform the remainder of the project and are next picked up by our Deliverable 3.1. "Pathways for New Societal Trends and gap analysis for demand models" (Yu et al, 2021).

The results presented in this deliverable build the basis for the upcoming work in the project, where the identified new societal trends and their narratives will inform the enhancement of our energy demand models, which are frequently used to model European long-term scenarios. Furthermore, the narratives will contribute to the scenario development and the cross-sectoral modeling of the trends. This will lead to a better understanding of potential non-linear developments of future energy demand and how energy (efficiency) policies could be designed to take these trends meaningfully into account.

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1. Introduction

1.1 New Societal Trends and their impact on energy demand

That our societies are in a state of constant flux is no surprise, and the availability of reliable and nearly ubiquitous access to energy has fueled the radical change of the past 150 years. With energy being so integral to all manner of lifestyles within the EU, one might think that our knowledge of energy supply and demand would be sufficient to accurately 'know' what the future has in store for changes in energy demand in the future. Unfortunately, for a number of reasons, such is not the case.

Though our knowledge of energy systems, and the historical data at hand, give our contemporary modeling capability an unprecedented edge over prior generations of this technology, the complex relationships that support our societies often give rise to the unexpected. New societal trends (NSTs) can be understood as emergent aspects of our dynamic, interrelated societies– unpredictable in both their individual, and collective impacts. These can be economic, political, ecological, cultural and social in nature, and can have an important influence on the EU's prospective energy demand.

When attempting to make long-term projections with respect to energy demand (or anything else for that matter), it is often useful to look towards ideas which, from our current stand point, might look more ridiculous to better capture the possibilities the future holds. For instance, only 30 years ago, the 'Internet' was vastly different–and few imagined (or believed) it would become a central component of our economic, social and political lives. The 1991 internet was more often projected as becoming a vast knowledge database, with the democratization of free, accessible, knowledge being the key to its democratizing power. At the end of 1993, there were 623 websites in total online. Within a few years, it had become a) commercial space (Amazon established 1995, eBay 1995), b) an entertainment space changing the way media is created, distributed and consumed (YouTube 2005, Spotify 2006), and c) a social space where strangers could talk around the world (Facebook 2004).

And while it is true that the internet has shaped much of our information or network societies, we must also realize that our societies have also shaped the technologies that drive the internet. An 'Internet' engineer of 1991 would likely find the energy demands of distributed ledger technologies (blockchains, cryptocurrencies) to be prohibitively expensive, and would discount the possibility that such a technology could emerge. The energy demands of the computing infrastructure of these services alone might have been unthinkable to someone 30 years ago, let alone the broad societal consequences of such web technology.

This highly curtailed history of a single technology is only meant to illustrate just how vast the ramifications of a change in one system can be, and the types of 'unthinkable' consequences such shifts can have for energy demand. It is for this reason that we cast a very wide net when searching for NSTs to include in the newTRENDs project. To better model energy demand, we must account for the secondary, tertiary, and further removed systems wherein "butterflies flap their wings", and new engines of demand might emerge. At the same time, we are living through the beginning of the largest scale shift in ecological conditions our species has ever faced, with changes underway that will reverberate across the human and non-human world. Changes to

our eco sphere have influenced, and will continue to impact all systems on our planet, and our energy systems are directly linked to our changing climate.

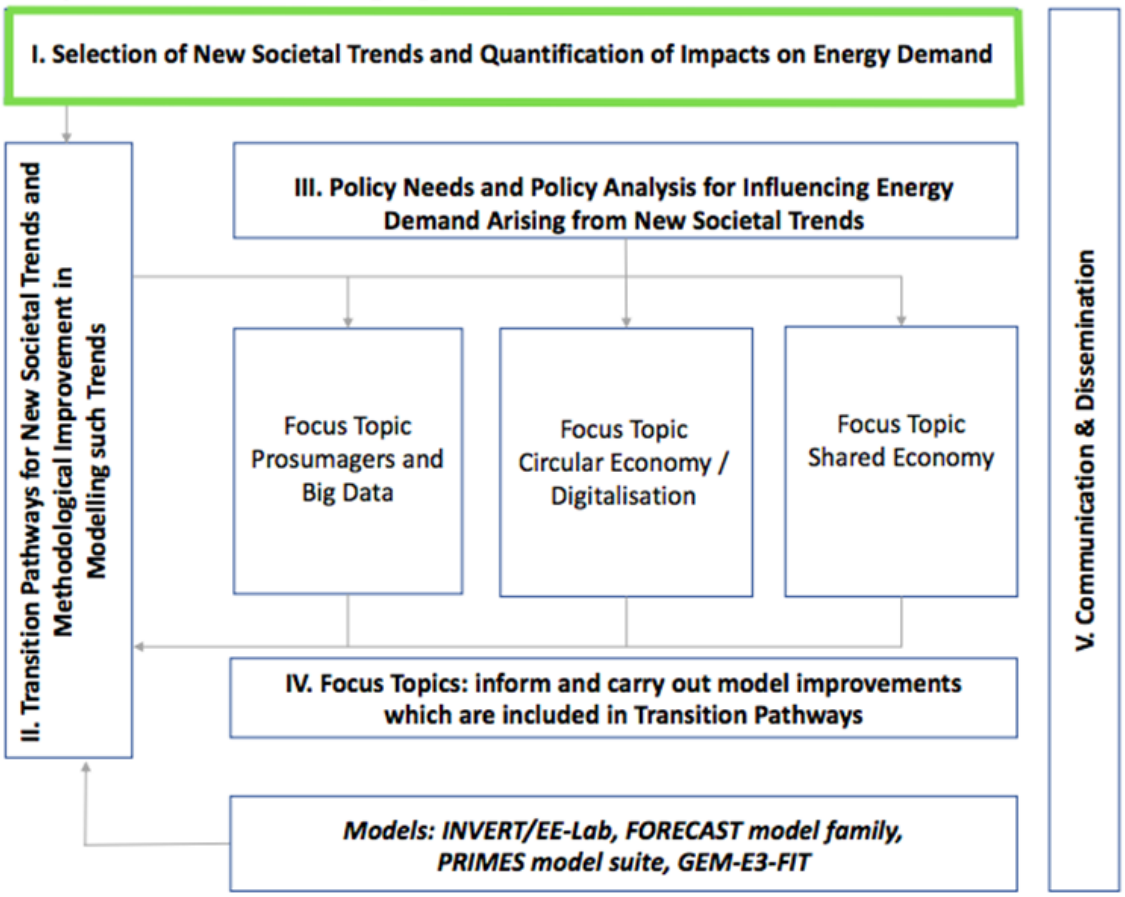
Climate change and environmental degradation present a significant threat to Europe and the whole world. To overcome these challenges, the European Commission has developed the European Union's (EU) new growth strategy called "The European Green Deal" aiming to make Europe the first climate neutral continent in the world by 2050, in line with the objectives of the Paris Agreement (UNEP, 2014). This action plan aims to make the EU's economy sustainable through boosting the efficient use of resources by moving to a circular economy, restoring biodiversity and cutting pollution (European Commission, 2019). In 2020, the European Commission presented the plan to reduce EU greenhouse gas (GHG) emissions by at least 55% by 2030, compared to 1990 levels, in order to achieve climate neutrality by 2050 (European Commission, 2020a). This new target is based on a comprehensive impact assessment of the social, economic and environmental impacts of GHG emissions and climate change. Nevertheless, the European Parliament raised the bar even further, proposing a reduction of 60% in 2030, compared to 1990 levels, and insisted that both the EU and all member states individually must become climate-neutral by 2050 and therefore the EU shall achieve "negative emissions" (European Parliament, 2020).

The EU Long-term strategy 2050 develops possible scenarios to a climate neutral EU in 2050 (European Commission, 2020b), aiming at the full deployment of all technology options, while other scenarios assume an increase in climate awareness of EU citizens translating into lifestyle changes and consumer choices, as well as a more circular economy (European Commission, 2020b). The achievement of the long-term EU climate goals implies the continued progress towards a low-carbon society, in which both technological and non-technological factors influence the success of reaching national and regional targets for energy and climate. Building from previous research, non-technological factors with the potential to impact future energy demand now have a broader framing as new societal trends.

1.2 Objectives of the second work package

The second work package of the newTRENDs project "WP2 – Selection of new societal trends and quantification of impacts on energy demand" encompasses a process of selecting clusters of new societal trends (see Stage I on Figure 1), which are integrated into the relevant demand side models for quantitative analysis in the further work packages.

Figure 1: Overview scheme of the newTRENDs project



The WP2 objectives involve two main tasks:

- selection of (energy-relevant) trend clusters and detailed trends and establish their relevance for energy demand,
- quantification of empirical data on new societal trends and their impacts on energy consumption.

This deliverable is devoted to the first objective. The second objective is then more explicitly addressed in the Focus Studies (WP 5-7).

In previous work, the following clusters of NSTs were identified, which are likely to highly affect future energy demand (Brugger et al., 2019; Fraunhofer ISI, 2019):

- trend to prosumage (i.e. transition to energy consumers as active future participants in energy generation, energy storage, demand shift and possibly energy markets) (WP5),
- establishment of a circular economy and a low-carbon industry (WP6),
- digitalization of the economy and private lives (WP6),
- sharing economy with decreasing or increasing impacts on energy demand and the decarbonization of the energy system (WP7).

Based on a review of qualitative foresight studies and a series of expert workshops, the following approach has been taken to identify the mechanisms that underlie the relations between these trends and future energy demand (see Figure 2 for details):

- selecting energy relevant NSTs;

- clustering and assessing of potential importance and disruptiveness of trends;
- developing narratives for the resulting trend clusters.

1.3 Theoretical background

The development of future energy demand is dependent on technological and societal innovations, as well as on societal mega-trends (Fraunhofer ISI, 2019). While long-term energy demand scenarios take technological potential and classical drivers of energy demand into account, we argue that this traditionally technocratic approach needs to be extended to take new societal trends into account. Societal trends and innovations often emerge with the development of new technologies, and could have a substantial and potentially disruptive impact on future energy demand. However, the underlying complexity of some of these trends is often unaccounted for, or not fully understood. As large-scale trends like "Digitalization" continue to demonstrate, complex, systemic changes give rise to numerous novel challenges, advances, solutions, opportunities, etc., and in so doing affect measures like energy demand in an equally complex way. Nonetheless, these large-scale trends cannot be ignored, given their powerful potential to effect change, and the newTRENDs project is an attempt to begin accounting for this influence, despite each trend's layers of complexity.

By new societal trends we understand societal developments arising from general mega-trends, which can have potentially large (increasing or decreasing) impacts on energy consumption. This includes cross-sectoral demand shifts because they are not simply the extrapolation of already presently observed trends ("continuous or linear trends") but may accelerate non-linearly when they are embraced by larger parts of the society ("disruptive or non-linear trends"). Based on previous research (Brugger et al., 2019; Fraunhofer ISI, 2019), in this project we particularly consider the trends of (1) prosumaging; (2) circular economy; (3) digitalization and (4) sharing economy.

Some of these new societal trends, in particular digitalization and its impact on energy consumption (e.g. IEA/OECD, 2017; EUSEW, 2019), but also the sharing economy (e.g. Perboli et al., 2018) and the circular economy (SITRA, 2018) have already received quite some attention in literature. Still, a full quantitative and cross-sectoral investigation of such new societal trends in energy demand modeling, including the analysis of data and modeling gaps to quantification, is missing. A recent study by Fraunhofer ISI (2019) has shown the large interest of stakeholders in a broad, structured and quantified analysis of these new trends (EUSEW, 2019) as well as in an analysis of policies that can influence the demand-increasing trends while enhancing the demand-decreasing effects of new societal trends.

Currently, national low-carbon and long-term energy scenarios that have been developed in European countries (e.g., European Commission (2010), IEA/OECD (2017), Ricardo (2017)) take into account the general social context of the energy transition (e.g. population, GHG intensity, average standard of living, education level, etc.). Nevertheless, they are lacking in particular a view on non-technological factors of influence on energy demand, notably by new societal trends, such as digitalization, sharing economy, circular economy, prosumaging, etc. A number of scenarios present a major step forward by integrating new societal trends, but more progress is necessary to improve the empirical basis for these trends and their representation in models, in particular covering the demand side. In addition, not much research has been done on how new societal trends may play simultaneously in opposite directions (e.g. decreasing and increasing energy demand at the same time), as well as how they

may enforce or contradict each other. Another open question is what policy measures are needed to ensure that these trends contribute positively to sustainable development. Therefore, the main goal of this research is to analyze how new societal trends may influence the European future energy demand in different sectors (increasing, decreasing or shifting) in order to identify the most relevant trends, enhance the energy demand models to capture these trends and integrate these assessments into the relevant demand side models for quantitative analysis in the further scenario development.

1.4 Results and implications

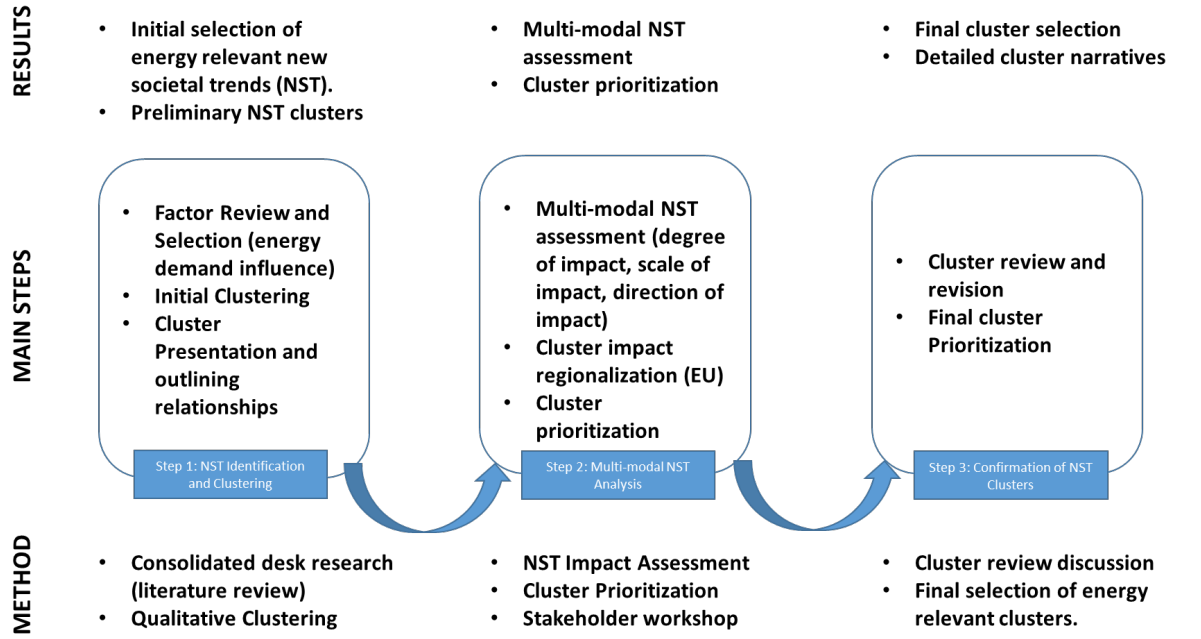
The results of this research will serve as input to the energy demand models, which are enhanced to modeling such new societal trends, e.g. through agent-based and cross-sectoral approaches. Furthermore, the trend narratives build the basis for scenario work and the cross-sectoral modeling of the trends. They will be of interest to policy makers, researchers and the general public, to analyze the impact of new societal trends on future energy demand in different sectors and discuss how this understanding may contribute to development of more effective energy policies.

2. Methodology

In this research, we identify and analyze the new societal trends that are expected to be most relevant or disruptive for future energy demand. We explicitly take trends into consideration, which might have increasing as well as those that might have decreasing effects. This is done in three consecutive steps (see Figure 2):

- **Step 1.** Energy-relevant new societal trends are selected based on an analysis of previous foresight studies and long-term energy demand scenarios.
- **Step 2.** In three expert workshops, the trends are clustered, and their potential importance and disruptiveness is assessed.
- **Step 3.** Narratives for the resulting 14 major trend clusters are developed describing the potential mechanisms of their impact and disruptiveness for future energy demand.

Figure 2: Process of selection of new societal trend clusters

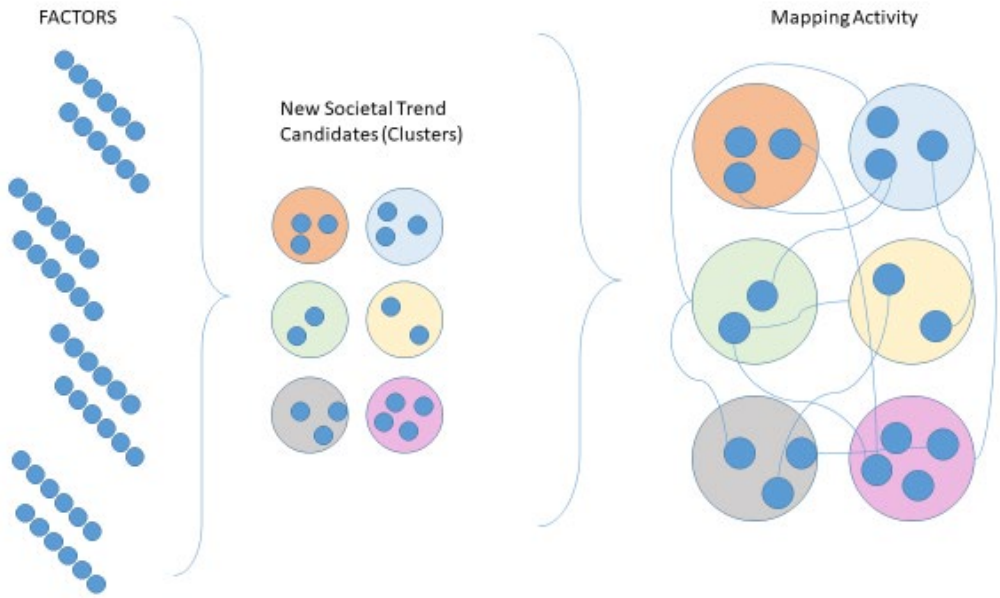


Environmental scanning (Slaughter, 1999; Toivonen and Viitanen, 2016) and horizon scanning (Cuhls, 2020; Könnölä et al., 2012) methodologies are essential to the factor discovery and identification in Step 1. To better facilitate the newTRENDs workshop series, initial research focuses on identifying key ***factors*** – trends, social conditions, emerging issues, events – that create societal change and could influence future energy demand. These factors are gathered from a review of previously published foresight research including holistic assessments of changes affecting the futures of the EU (European Commission, 2020c; Gaub, 2019), global systems of governance (Rosa and Roess, 2019), and social innovations (Warnke et al., 2019; Zweck et al., 2017).

The newTRENDs workshop series was designed to leverage expert knowledge in the identification of new societal trends with the strongest potential to influence future energy demand. The process is visualized in Figure 3. New societal trends are hereby

understood as clusters of factors. Identification activities were coupled with methods to map and clarify interrelationships between these trends, to provide future modeling efforts with conceptual outlines. In total, over 240 factors with the potential to influence, or continue influencing societal change were identified through horizon scanning research, and were utilized as the basis for the first and the second workshops. Starting with the identified factors, initial clustering was conducted to gather closely related factors into the broader classification of ***new societal trend candidates*** (Glenn, 2003) – indicating that the clustered factors, when taken together, can outline a new societal trend in line with our working definition of the term. The clustering exercise was run in parallel with a conceptual mapping activity (Keenan and Popper, 2007) that encourages participants to articulate relationships between both, the new societal trend candidates (clusters of factors), as well as between individual factors within each cluster (Saritas and Nugroho, 2012). This procedure enabled the possibility for a two-tiered analysis of the results while acknowledging the social constructionist perspective on future knowledge (Fuller and Loogma, 2009). These *new societal trend candidates* and their underlying factors were the primary inputs for the trend assessment work of the second workshop. During the second workshop, new societal trend candidates were selected for further research and integration into the next wave of project work packages.

Figure 3: Schematic overview of the new societal trend identification and mapping process



The goal of Step 3 was to synthesize narratives for selected ***new societal trends*** (NST) and prioritize them with respect to the overarching goal of the newTRENDs project – the enhancement of energy demand models to account for new societal trends shaping future energy demand. The development of new societal trend narratives is intended to clearly communicate the reasoning behind the inclusion of certain factors within each NST, and to articulate the inter-relational dynamics that were given during expert discussions (Milojević and Inayatullah, 2015). These narratives are meant to illustrate the core dynamics and effects of each cluster as highlighted during expert review and are meant to guide future modeling efforts. However, these narratives may

ultimately turn out to be only partially true, or even false, since they represent a record of current expert discussions, but not statements of empirical facts. Telling the story of how new societal trends might be explored using quantitative methods, in an effort to engage the community of modelers who will undertake that translation (Moezzi et al., 2017). As the final workshop includes members of the newTRENDs consortium, the NST narratives are meant to foster critical discussion and ultimately facilitate the selection of clusters to take forward into modeling research in the following work packages.

2.1 Workshop Series Overview

The newTRENDs workshop series is designed to leverage expert knowledge to identify important societal trends, issues, events and conditions with the strongest potential to affect future energy demand, and the interrelationships between these factors. Over the course of three workshops, experts and newTRENDs team members work to define clusters of factors whose impact on energy demand is the most important.

Given the ongoing Covid-19 pandemic and the accompanying restrictions on travel and person-to-person meetings, the workshops are designed to take place using two online platforms. Microsoft Teams (MSTeams[1]) is used for audio and visual communication, while Miro[2] is used as an online whiteboard application for interactive exchanges. These tools will be referenced across the different workshop descriptions, as their different capacities for communication and interaction set design parameters for the workshop methods.

2.2 Research for workshop inputs

To better facilitate our workshop series, initial research is focused on grounding the workshop design within a contemporary view of the factors – trends, issues, technologies, behaviors and dynamic conditions – that create societal change and might impact future energy demand. These factors are gathered from previous research projects conducted by the Fraunhofer ISI Competence Center Foresight and by other sources of EU-specific foresight research. In total, over 240 societal factors were identified across these reports, and were used as initial inputs into the first workshop. In Table 1, we present the reference publications and a quantitative overview of the societal factors that are gathered in them. A full list with the new societal trend candidates and their underlying factors can be found in the Annex A.1.

1 https://www.microsoft.com/en-US/microsoft-teams/group-chat-software

2 https://miro.com

Table 1: Reference publications for gathering factors

Title of publication	Source	Year	Number of factors contri-buted
Energy efficiency vision 2050: How will new societal trends influence future energy demand in the European countries? (Brugger et al., 2021)[3]	Energy Policy	2021	25
Strategic Foresight Report 2020 (European Commission, 2020c)	European Commission	2020	48
RIBRI – Radical Innovation Breakthrough Inquirer (Warnke et al., 2019)	EC Project: Fraunhofer ISI (lead), Finland Futures Research Centre (Turku), Institutul de Prospectiva (Bucharest)	2019	50
Global Trends to 2030: Challenges and Choices for Europe (Gaub, 2019)	European Strategy and Policy Analysis System (ESPAS)	2019	14
TRIGGER – Trends Impacting Global Governance – D5.1 (Rosa and Roess, 2019)	EC Project: Center for European Policy Studies (Lead), Fraunhofer ISI (Foresight Lead)	2019	34
Social Changes 2030: Volume 1 of results from the search phase of BMBF Foresight Cycle II (Zweck et al., 2017)	BMBF Project: VDI Technologiezentrum, Fraunhofer ISI	2017	24

2.3 The first workshop

The main tasks of the first workshop are:

- to identify new societal trends and dynamics with complex implications for social change and the potential to impact future energy demand;
- to select factors with impact on future energy demand;
- to group the selected factors into initial *new societal trend candidates* (referred to sometimes as "clusters").

The first workshop starts with an overview of the newTRENDs project and a brief introduction to the strategic role of foresight in identifying new societal trends. Activities are organized within a shared online whiteboard (Miro), with audio and visual communication relying on MS Teams. Graphic representation of the activities has been included to provide visual references.

[3] This publication is part of the newTRENDs project and can be openly accessed here: https://doi.org/10.1016/j.enpol.2021.112216

2.3.1 Methodological design

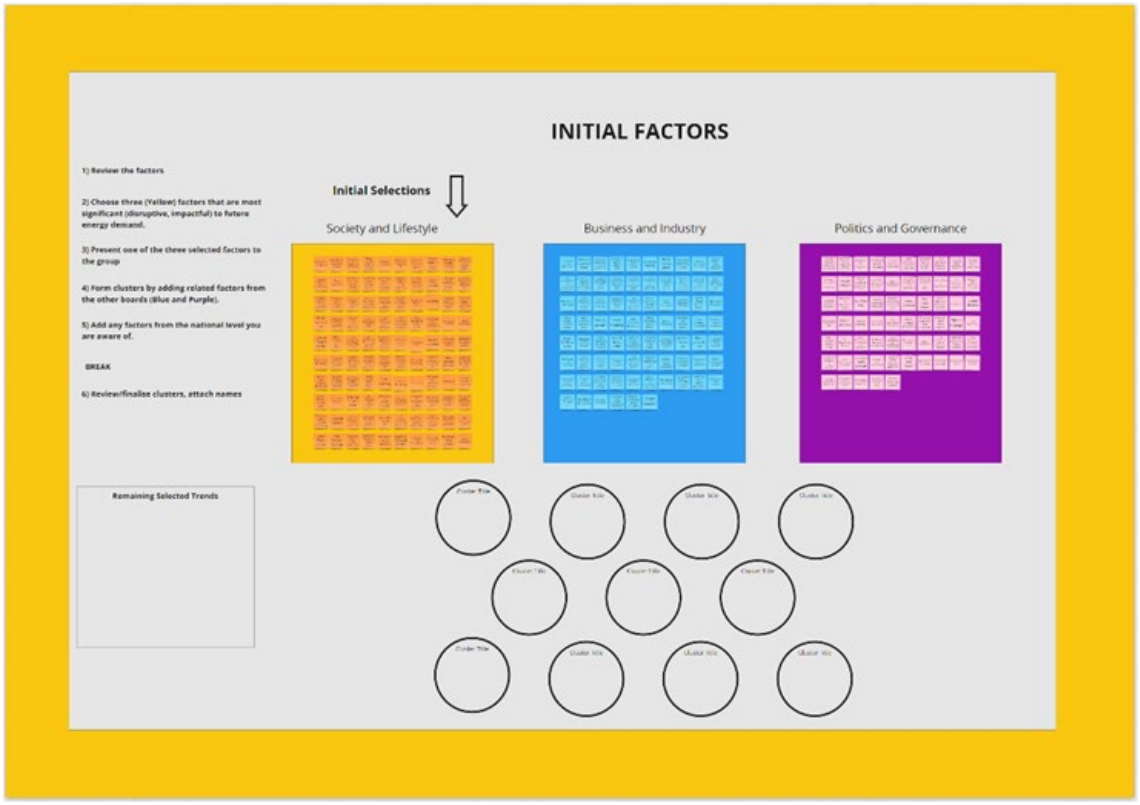
The first workshop includes four main stages:

- **Stage 1.** Review of research results and identification of additional factors that were not previously identified.
- **Stage 2.** Initial selection of factors with respect to their potential effect on future energy demand.
- **Stage 3.** Adaptation of initial clustering of social "factors" into new societal trend candidates ("clusters").
- **Stage 4.** Description of initial relationship between identified new societal trend candidates based on either a) individual factors relating across clusters, or b) holistic relationships between clusters as defined by participants.

1) Review of research results and identification of additional social trends and dynamics

The first phase of the workshop was organized to enable a differentiated assessment of the trends gathered from previous research (outlined above) according to three main categories – "social", "economic" and "political". To achieve this goal, the previously identified factors are separated into these three primary categories, and each of the smaller workgroups was initially tasked with looking over the collected factors, identifying any factors that were missing (Figure 4). Expert contributions were then added to the total list of social factors to be considered with respect to their potential effect on future energy demand.

Figure 4: The first workshop (Stage 1)



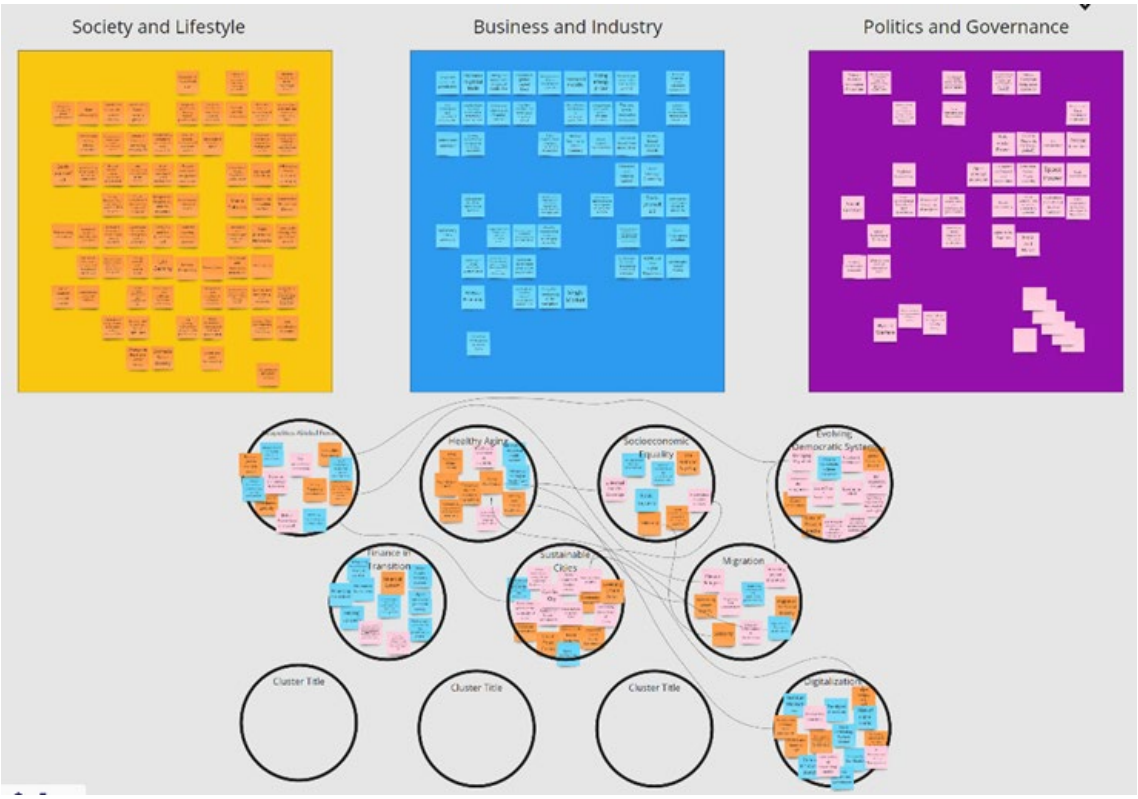
2) Initial selection of the social trends and dynamics

In the second stage of the first workshop, the participants of each small workgroup were asked to identify the three factors that they consider most important from the factor category they are assigned to ("social", "economic", "political"). Participants were asked to introduce their factors – meaning that each participant presented one of their selections, described their opinion of its importance to future energy demand, and placed it in the clustering workspace (on the online whiteboard). The second stage of the first workshop was designed to create a prioritized set of inputs for the clustering activity (Stage 3), so the presentation of one factor lead directly to the clustering activities described below. The presentation of prioritized factors was repeated until all factors have been presented, or until no time remained for the activity.

3) Clustering factors and discussing factor relationships

When participants moved a factor into a cluster, they explained the connection or relationship to the other factors assembled therein. This process continued for 3-5 minutes, with facilitators adding notes on factor relationships (Figure 5). After a cluster was completed, the next participant introduced one of their top three factor selections, presents it to the group, and the cluster formation process of deliberation and factor clustering was repeated.

Figure 5: The first workshop (Stage 3)

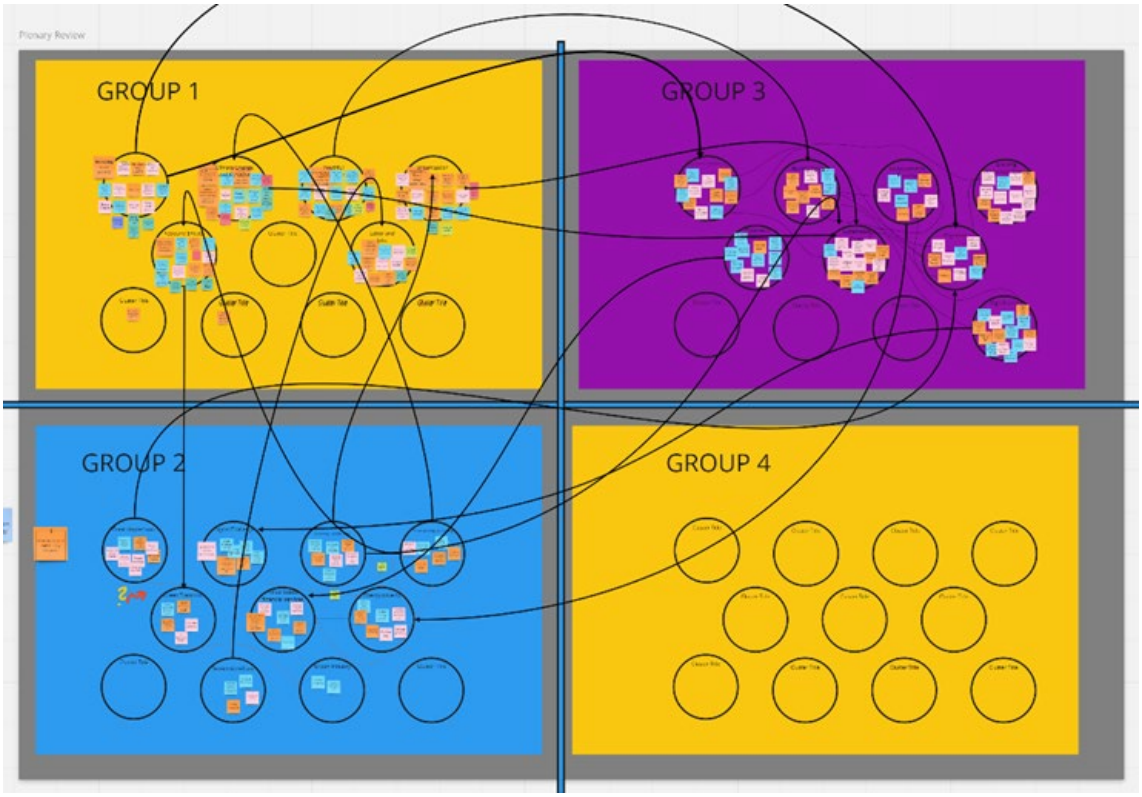


4) Description of initial relationship between identified clusters

The final stage of the first workshop was organized as an interactive plenary session. At the beginning, all workgroup participants are brought together into a single "room" – meaning that all participants are connected via audio and visual communication. The primary facilitator used a "shared screen" function to unify the participants' view

of the workspace, and guided the plenary session to a group-by-group overview of the workgroup results. During this review stage, one of the experts from each small workgroup presented the clusters that they have developed, including the underlying factors and the clusters overarching relationship to energy demand (Figure 6).

Figure 6: The first workshop (Stage 4)



After each group had presented their respective clusters, the plenary discussion shifted to identifying and explaining relationships between the different groups' clusters. This activity was conducted in an open dialog format, with participants signaling when they would like to contribute to the discussion. Active transcription was used to capture participant contributions, including visualization methods used to illustrate inter-cluster relationships more clearly. This activity concludes the workshop.

2.4 Activities between the first and the second workshops

To enable a productive second workshop, the results of the first workshop were organized and placed into a standardized format that can be transferred between online whiteboard workspaces. During this process, factor clusters from the workshop were merged, revised, and given categorical titles, as part of their transition into *new societal trend candidates*. Some clusters from the first workshop were merged, following the guidance of both experts, attendees and newTRENDs consortium leadership. Where cluster titles were not assigned in the first workshop, they were added for each cluster, and all clusters were given short descriptions (Figure 7). Additional analysis was conducted to examine the utilization of factors across NST candidates and across different workgroups.

Figure 7: The results of the first workshop

2.5 The second workshop

The main tasks of the second workshop were:

- to review NST candidates generated in the first workshop and the underlying factors that make up their composition;
- to assess underlying factors of each cluster based on a scale of operations and estimate their impact on future energy demand;
- to account for disruptive factors, or combinations of factors, within each NST candidate.

The initial phase of the second workshop was focused on a brief overview of the NST candidates that have emerged from the first workshop. This phase established a procedural context for the participants of the second workshop, placing the rest of the activities within the scope of the larger outputs of the workshop series. After the review session, participants were distributed to five smaller workgroups to better facilitate productive dialog between experts for the assessment of NST candidates

and compositional factors. Activities were again organized within a shared online whiteboard (Miro), with audio and visual communications relying on MS Teams. Graphic representation of the activities has been included to provide visual references.

2.5.1 Methodological design

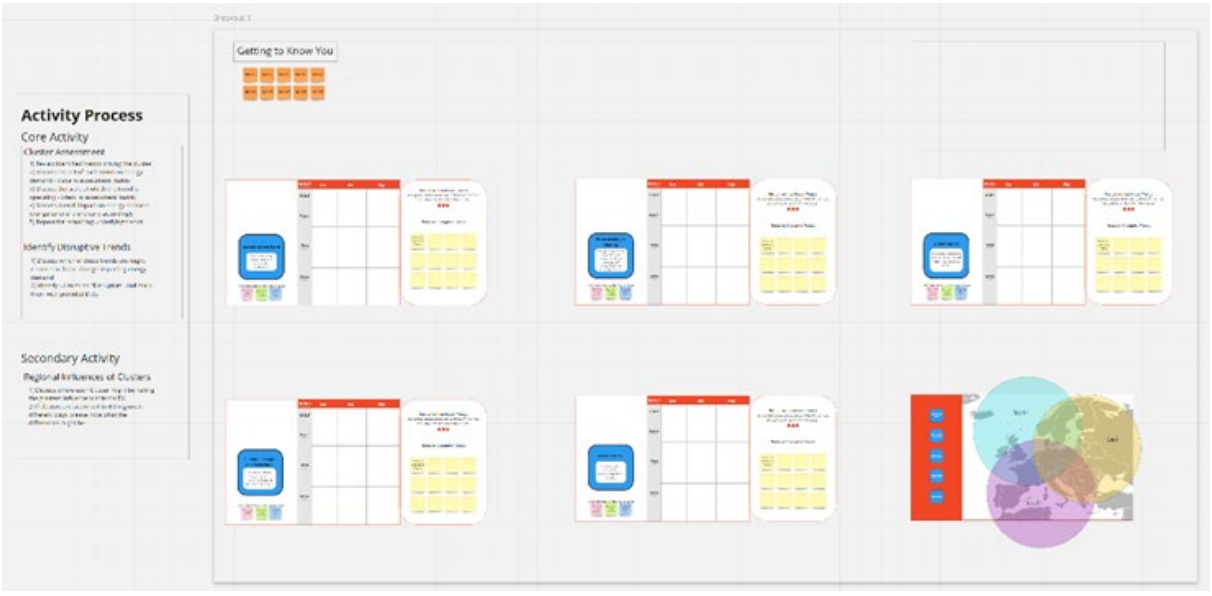
The second workshop includes four main stages:

- **Stage 1.** Review of NST candidates produced in the first workshop, and underlying factors in each.
- **Stage 2.** Assessment of underlying factors within each NST candidate based on a two-dimensional grid (impact degree, impact scale) with color coding to show directionality of change.
- **Stage 3.** Discussion of those underlying factors that have the potential to be disruptive forces in future energy demand, creating non-linear changes either alone or in combination with other factors.
- **Stage 4.** Selection of the NST candidates that should be prioritized in future attempts to model energy demand dynamics.

1) Review of NST candidates produced in the first workshop

Each workgroup was given four NST candidates to examine and assess in greater detail. The first activity was to review the clustered factors and their short descriptions as led by the group's facilitator. Then the group began reviewing the individual NST candidates, by revealing the underlying factors (identified in the first workshop) and engaging in a short deliberation about those factors. Figure 8 provides an illustration of the whole Miro board setup. A more detailed visualization of the process can be found in Figure 9 and Figure 10. Participants were free to ask questions about the underlying factors and contribute additional factors to the NST candidate. Once this discussion concluded, the participants were encouraged to begin the next activity.

Figure 8: The second workshop (Stage 1)



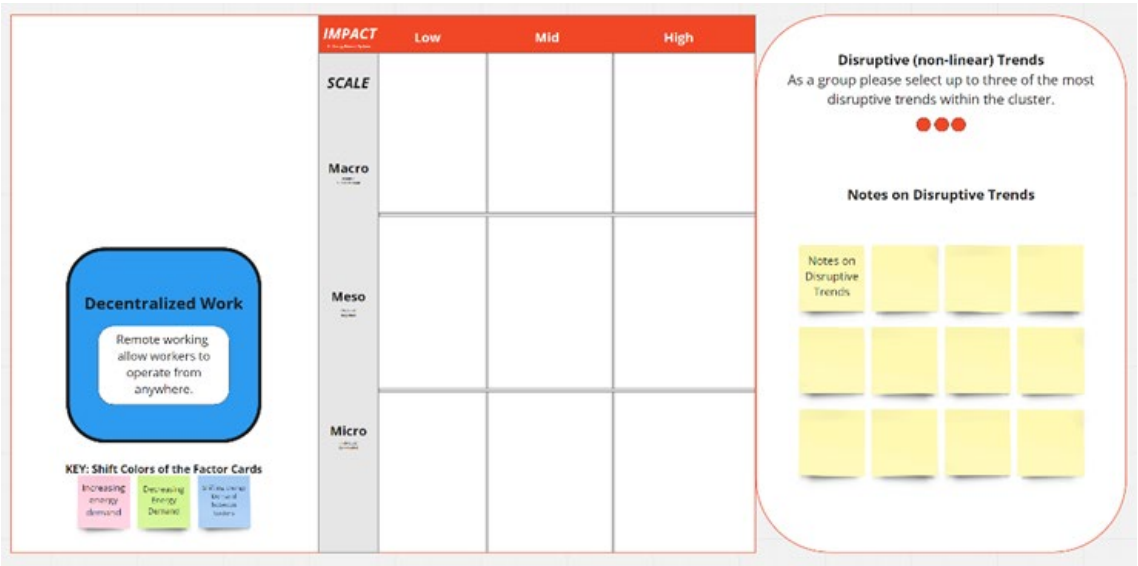
2) Assessment of underlying factors within each NST candidate

The next workshop phase was a facilitated assessment of the underlying factors with respect to impact (on energy demand) and scale of effect:

- based on their expected **degree** of impact on future energy demand (low, medium or high),
- based on **scale** of operation – meaning at what level of society do these factors operate – micro (individuals or small communities), meso (urban areas, regions or states) or macro (supranational, global);
- based on the **direction** of that impact (increasing, decreasing or shifting energy demand) using factor card colors (pink, green, blue, respectively).

This assessment was carried out in an open dialog format, with expert discussion guiding the selection and placement of underlying factors on the assessment grid (Figure 9). Participants were encouraged to select one of the underlying factors, place it on the assessment grid according to both scale and impact and provide an oral explanation of their assessment. After hearing the argument for the assessment, other workgroup members were encouraged to support or challenge the assessment. During the discussion, facilitators and participants contributed notes on the discussion, outlining the details of the factor assessment and highlighting the relationships that underlying factors have with one another. In some instances, underlying factors would be placed in more than one area of the assessment grid, visually demonstrating that the factor is operating at more than one scale, and that impacts to energy demand could be different, based on these scaling differences. The discussion also engaged with the directionality of energy demand change (increased or decreased) induced by the assessed factor, and the expert opinion was recorded using the dynamic color attributes of the Miro board notes: pink (increased energy demand), green (decreased energy demand) and blue (energy demand shifted between sectors).

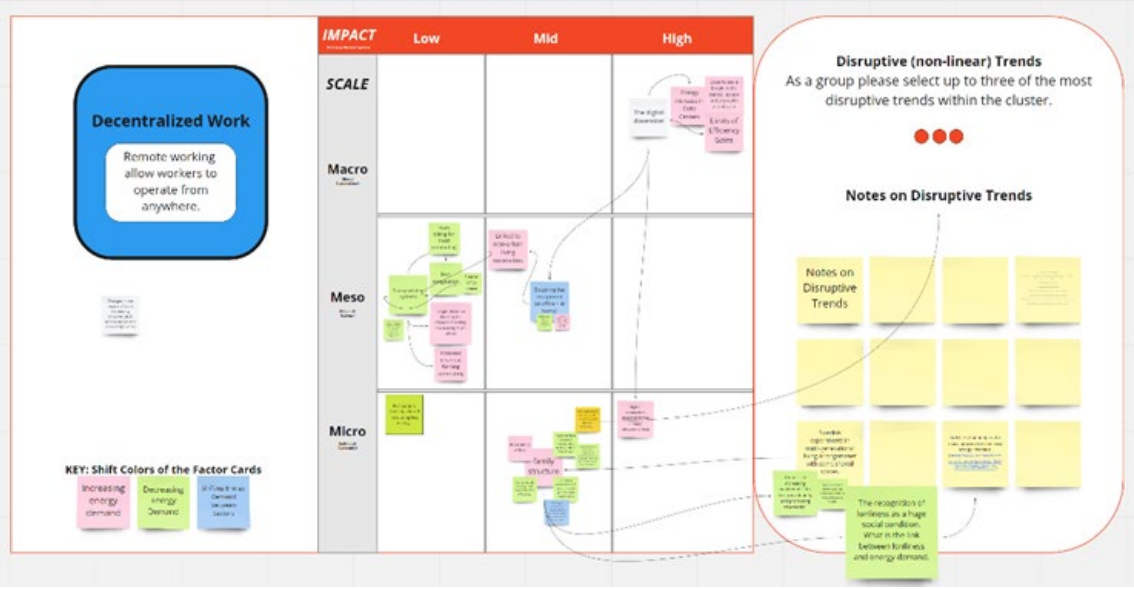
Figure 9: The second workshop (Stage 2)



3) Discussion of underlying factors that have the potential to be disruptive forces in future energy demand

The identification of potentially disruptive underlying factors, or combinations of factors, was designed as a separate activity that can be engaged after all cluster factors have been assessed (Figure 10). In practice, given the fluidity of open dialog, and the ease with which visual notes can be captured with digital whiteboard tools, this activity was often integrated into the work groups' assessment dialog. For this activity, outlining disruptive potential was defined as identifying the conditions and relationships that could enable one or more factors to have a non-linear effect on energy demand (increasing or decreasing).

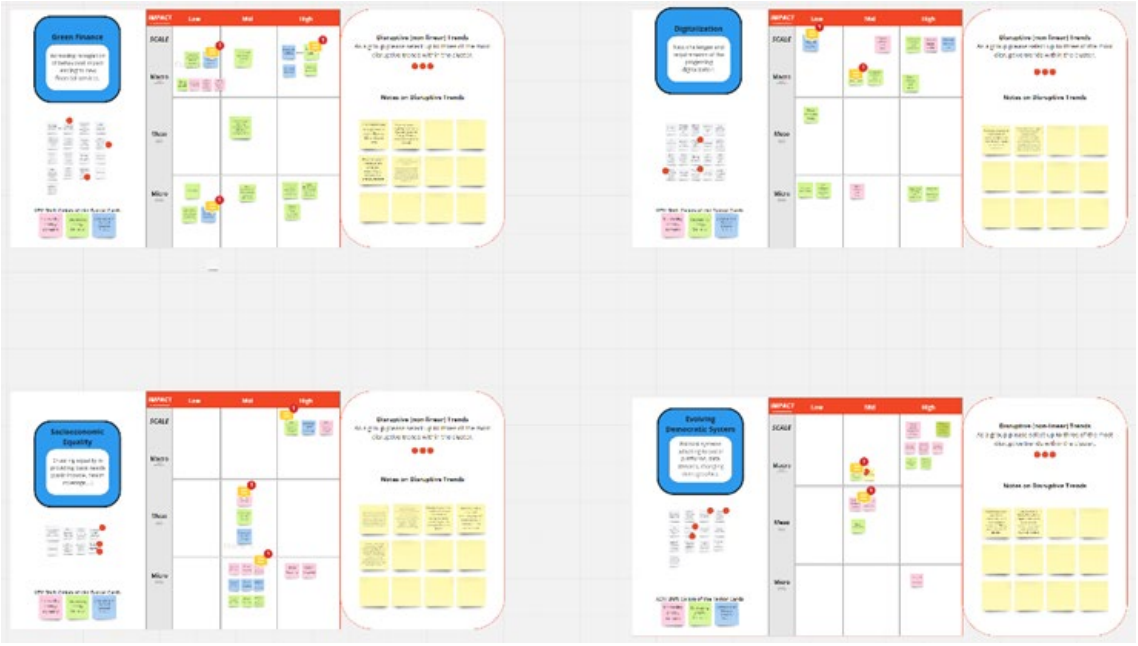
Figure 10: The second workshop (Stage 3)



4) Selection of the NST candidates that should be prioritized

The final activity of the workshop was conducted in plenary, with all participants engaging in a review of the work accomplished in the small group sessions and an open dialog concerning the factor assessments (Figure 11). Participants were welcomed to question assessments and their reasoning, while each group presents the results of the considered clusters. After this review process, the participants engaged in a prioritization activity, in which the NST candidates were ranked according to their potential to influence future energy demand. Each workshop participant was allowed to “vote” for four clusters. This was followed by a round of feedback and suggestions.

Figure 11: The second workshop (Stage 4)



2.6 Activities between the second and the third workshops

To facilitate a streamlined and productive meeting in the third workshop, the products of the assessment activities are reviewed and NST candidate "narratives" were written to explain identified dynamics and relationships. These descriptive narratives describe high impact compositional factors, their interrelationships, and potentials for disruptive change through combinations or dynamic environmental conditions. These narratives become the centerpiece for the third workshop, as they summarize the efforts of two previous workshops into approachable texts that can be quickly read, expanded and utilized.

2.7 The third workshop

The main tasks of the third workshop are:

- to review NST candidates and their accompanying "narratives", explain underlying factors' scale, impact, and interrelationships,
- to review the initial NST candidate prioritization that emerged from the second workshop,
- to amend both narratives and NST prioritization for newTRENDs work commencing in WP3.

The initial phase of the third workshop was a review of the NST narratives written by the project team. Each narrative provides details about underlying factors within each trend as derived from the assessment matrix results of the second workshop. These descriptive narratives outline the relationships between factors and describe expert assessments regarding the conditions that can make the trend more disruptive to future energy demand. The second phase of the third workshop evaluates the initial prioritization results of the 20 societal trends (the second workshop). During this

phase, NST candidates were combined and reprioritized based on project goals and consortium discussion. The third phase includes finalization of the priority *new societal trends* with respect to ongoing project work packages. Activities are organized within a shared online whiteboard (Miro), with audio and visual communications relying on MS Teams. Graphic representation of the activities has been included to provide visual references.

2.7.1 Methodological design

The third workshop includes three main stages:

- **Stage 1.** Review and assessment of cluster narratives.
- **Stage 2.** Editing and expanding of cluster narratives.
- **Stage 3.** Plenary discussion for final prioritization.

1) Review and assessment of cluster narratives

The first activity in the third workshop was held in a plenary session, so that all participants could discuss freely and openly during the review of the cluster narratives. During the initial review activity, all of the NST candidates were presented according to the prioritization that was determined at the conclusion of the second workshop. The review activity allows individual participants to read over the narratives and provide feedback via notes embedded in the Miro board. The initial activity was designed to give all participants an overview of the NSTs and their consideration for uptake into upcoming newTRENDs work packages. Participants were encouraged to pay especially close attention to those factors that have received a medium number of votes in the second workshop. Many of these issues have been identified as interrelated in the first workshop, and some of them have not been thoroughly addressed in the assessment activities of the second workshop, owing to time limitations.

2) Editing and expanding cluster narratives

After the review of the NST candidate narratives, participants are encouraged to revisit those deemed important for future newTRENDs work to incorporate. This activity moves participants into smaller workgroups once more, to facilitate more open dialog. Workgroups are encouraged to consider the totality of the cluster narrative list in their deliberations. During this process participants are encouraged to amend the narrative texts, add additional factors, and further clarify each cluster's effects on future energy demand. Elements of this activity, particularly the addition of new factors, are accomplished during the initial review (above). During this activity, participants are also encouraged to begin thinking about how clusters might be reconceived so as to align with both project focus areas (e.g. circular economy was not an explicit cluster that emerged from the first or second workshops), and how clusters might be merged under new titular clusters to better account for previously identified interconnectivity (the first workshop).

3) Plenary discussion for final prioritization

The final activity was held in plenary of the consortium leadership and attendant experts. This activity was focused on finalizing a categorization scheme that would classify the identified clusters regarding their inclusion in future newTRENDs work packages. An informal classification schema – described below – was utilized during the discussion with four categories of clusters:

- **"Universal"** – all work packages must address these NSTs and included factors in their research and development. Not all of them are required to be modelled, but they must clarify the reasoning behind leaving one or more of these clusters out of future research.
- **"Nice to Have"** – these are NSTs that are identified as being of high priority, but not mandatory. Consortium teams are encouraged to include as many of these clusters as possible, but are not required to justify their exclusion.
- **"Optional"** – these NSTs are deemed to be of relatively low priority and could be considered under special circumstances (for instance, the cluster is related to ongoing research efforts).
- **"Future research"** – the final category was reserved for NSTs considered beyond the scope of newTRENDs model development efforts. They are suggested as future research avenues that could be explored in follow-up projects.

During this activity, the clusters are placed within the aforementioned categories, cluster aggregation is finalized as suggested by the experts, and final consensus is achieved through dialog and debate amongst newTRENDs consortium members.

3. Workshop Results

3.1 Results of the first workshop

In the first workshop, three working groups (social, economic and political) created 22 clusters composed of the preliminary identified factors (the total number of factors was 241):

- **"Society and lifestyle"** (social) workgroup: 6 clusters
- **"Business and industry"** (economic) workgroup: 8 clusters
- **"Politics and governance"** (political) workgroup: 8 clusters

It should be noted that participants were encouraged to duplicate underlying factors that corresponded to more than one cluster. Also, given that the initial factor list was the same across all workgroups, some underlying factors were repeatedly used across the different workgroups. Further, to avoid duplicates, these 22 clusters were merged into 20 clusters. The final list of clusters and their underlying factors (after cleaning the factors duplicated within a particular cluster), that was created as a result of the first workshop, is presented in Table 2. The full list of the underlying trends per cluster can be found in Table 13 in the annex.

Table 2: The list of 20 clusters with description and underlying factors

Cluster name	Description	Number of underlying factors
Decentralized Work	Remote working allows workers to operate from anywhere	4
Water Issues	Increasing water scarcity effects multiple aspects of society	17
Sustainable Cities	The development of urban living spaces to meet future challenges	16
Climate Change and Behavior	Increasing climate change concerns requiring changing consumer behavior	15
From Owning to Sharing	The growing sharing culture enables innovative ideas in exchange of knowledge and promotes sharing platforms	5
New Labor	Increasing relevance of labor for societal participation	13
Digitalization	New challenges and requirements of the progressing digitalization	20

Cluster name	Description	Number of underlying factors
Urbanization	Changing perceptions of inequalities caused by the rural and urban divide	18
Green Transition	Determining an appropriate policy mix for relevant challenges	5
Green Finance	Increasing recognition of behavioral impact leading to new financial services	17
Migration and Displacement	Increasing global migration which requires fair access to water and modern energy services	8
Growing Middle Class	Growing urban middle class potentially contributing to sustainable urban development	6
Energy Poverty	Energy poverty and inequalities caused by rising energy prices	5
Growing Youthful Population	Growing population in Global South requiring sustainable education, high Internet coverage and social innovation	17
Healthy Aging	Increasing life expectancy and aging workforce in Global North due to advances in digital healthcare	10
Rebound Effect	Policy consequences detract from efficacy due to adaptation (market, consumer etc.)	15
Geopolitics and Global Forces	Role of the geopolitical dimension in trade, social aspects, demand/supply sides	12
Socio-Economic Equality	Ensuring equality in providing basic needs (basic income, health coverage, etc.)	8
Evolving Democratic System	Political systems adapting to social platforms, data streams, changing demographics	13
Great Depression II	Depression affecting the financial situation in the countries and increasing migration	8

3.2 Results of the second workshop

The second workshop produced a more detailed understanding of the composition and internal relationships of the previously identified new societal trend clusters with respect to future energy demand. The activities included a multi-modal assessment of each underlying cluster factor, and with respect to effect on future energy demand at different scales. Additionally, the second workshop provided the first expert-based prioritization of the clusters. This ranked list became an essential input to the third workshop, because the highest ranked clusters will set out the work plans and requirements for the next stages of the newTRENDs project.

Cluster (trend) assessment: degree, scale, direction

Based on the discussions with the experts during the second workshop, each cluster and its underlying trends was assessed using the following metrics:

- **"Impact degree"** (High / Medium / Low)
- **"Impact scale"** (Macro / Meso / Micro)
- **"Impact direction"** (Decreasing / Increasing / Shifting)

The example of assessment for "Sustainable Cities" cluster is presented in Table 3. The assessment for all other clusters can be found in Annex 2.

Table 3: Cluster assessment (example)

Underlying trends: *** selected by experts** **** selected by experts and called disruptive** ***** additional trends proposed by experts**	**Degree assess-ment**	**Scale assess-ment**	**Direction assess-ment**	**Additional narratives**
Sustainable Cities: **The development of urban living spaces to meet future challenges.**				
1)* Population size of urban settlements	Low	Meso	Shifting	
2)* Rise in the number of urban settlements	Medium	Meso	Shifting	
3)* Increased urbanization	Medium	Macro	Decrea-sing	
4)* Increasing land area of cities	Medium	Micro	Increasing	
5)* Urban governance – solving global challenges locally in cities	Medium	Meso	Decrea-sing	
6) The global urban middle class – tipping the scales of sustainable urban development?	-	-	-	
7)* Local food circles	Medium	Micro	Decrea-sing	
8)* Localized food systems	Medium	Micro	Decrea-sing	
9)** Car-free city	Medium	Meso	Decrea-sing	Car-free city allows cities to be "sustainable", making cities

Underlying trends: * selected by experts ** selected by experts and called disruptive *** additional trends proposed by experts	Degree assess-ment	Scale assess-ment	Direction assess-ment	Additional narratives
Sustainable Cities: **The development of urban living spaces to meet future challenges.**				
				attractive (greening, local food, public space).
10)* New transport models (hubs)	Medium	Macro	Decrea-sing	
11)* New cities without the necessity of a car	Low	Meso	Decrea-sing	
12)* Transportation systems *** Autonomous driving / sharing cars or vehicles (not only for cities)	High	Macro	Decrea-sing	
13)* Community gardening	Low	Meso	Decrea-sing	
14)* Reconquering the public space	Low	Micro	Decrea-sing	
15)** Hyper-connectivity	High	Macro	Increasing	Hyper-connectivity: data transport globally, data amount change, data availability, consumption and production patterns lead to infrastructure changes.
16)* Greening urban areas	Low	Meso	Decrea-sing	

Identification of disruptive trends

The experts selected and described the most disruptive trends under each cluster and in some cases proposed additional related trends that may also potentially influence future energy demand (patterns). In addition, experts selected the most disruptive trends within the clusters providing the clarifying remarks (narratives) for trends, especially with respect to assessments.

Assessment of regional influences

Moreover, it is important to note that the clusters under investigation may impact energy demand differently in specific regions. That is why additional information on how new societal trends may influence regional development was also collected during the second workshop.

Cluster prioritization

During the second workshop, 10 clusters with the highest priority were selected from 20 clusters through expert voting (see Table 4). They were considered by experts as the most important to be taken to the further analysis.

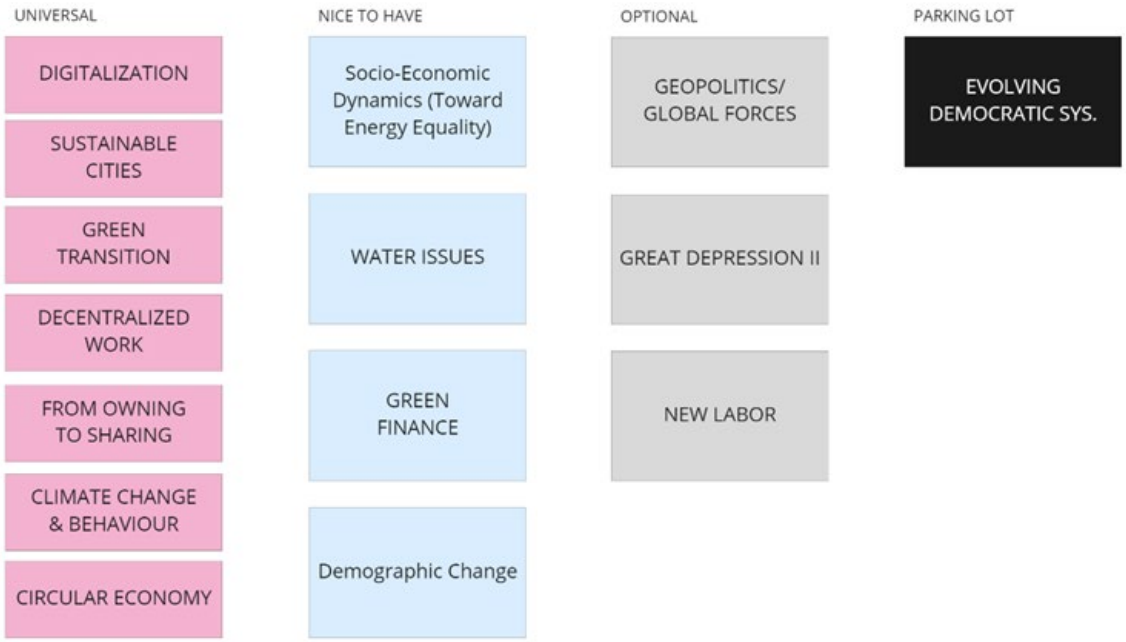
Table 4: Prioritization of trend clusters per voting

Cluster name	Category	Prioritization (votes received)
1. Digitalization	Political	14
2. Sustainable Cities	Political	12
3. Green Transition	Economic	9
4. Decentralized Work	Economic	8
5. Climate Change and Behavior	Social	7
6. From Owning to Sharing	Economic	7
7. Energy Poverty	Economic	5
8. Socio-Economic Equality	Political	5
9. Water Issues	Social	4
10. Healthy Aging	Political	4
Urbanization	Social	3
Green Finance	Economic	3
Growing Youthful Population	Social	3
Great depression II	Economic	3
Rebound Effect	Social	3
Geopolitics and Global Forces	Political	2
New Labor	Social	1
Migration and Displacement	Political	1
Growing Middle Class	Economic	1
Evolving Democratic System	Political	0

3.3 Results of the third workshop and Trend Narratives

The third workshop produced a final list of clusters (see Figure 12), categorized according to the clusters' integration with upcoming newTRENDs work packages. This included the creation of one entirely new cluster ("Circular Economy") and three amalgamated clusters: "Sustainable Cities" now includes also the trend candidate "Urbanization". "Socio-Economic Dynamics" was combined from the candidates "Energy Poverty", "Socio-Economic Equality", "Rebound Effect" and "Growing Middle Class". Lastly, the cluster "Demographic Change" was created based on "Healthy Aging", "Growing Youthful Population" and "Migration and Displacement" The final result was that there were 15 clusters, with 7 identified as "universal", 4 identified as "nice to have", 3 identified as "optional" and 1 cluster placed into the "parking lot" for future research.

Figure 12: Results of the third workshop



The descriptive narratives were developed for the resulting 15 clusters to understand the potential mechanisms of their impact and disruptiveness for future energy demand (see below). The claims in these narratives should be considered as hypothetical and yet to be tested.

1) "Universal" trend clusters

Digitalization

This cluster summarizes all kinds of trends, which are related to digitalization. Digitalization is seen as an enabler for a sustainable energy transition. At the same time, it is a driver of increasing energy demand in itself. This trend includes both developments. On one hand, including the rise of digital data storage and traffic and its corresponding increase in energy consumption of data centers and networks as well as the increase in digital hardware production. On the other hand, it includes changes in the sectoral energy demand through digitalization and enables energy and resource efficiency (e.g. in the transport sector through the trend of increasing virtual

work or in the industrial sector through industry 4.0 and an increasingly circular economy).

Acceleration of virtual work (COVID-19) may have high or medium impact at macro level, contributing to decreasing energy demand in different sectors (transportation, urban infrastructure, work spaces, etc.). Digital literacy plays an important part in how energy demand is impacted as work and education shift to greater digitalization – with some digital practices causing greater demand for energy inputs than others.

Sustainable Cities

In this cluster, different trends aiming at overcoming future challenges (e.g. food supply, transportation and urbanization) of urban living spaces were gathered. Focusing on urban settlements, these trends are expected to have a low to medium impact on decreasing future energy demand, mostly on the meso scale.

A notable exception is the hyper connectivity trend (closely related to the "Digitalization" trend cluster), which will have a disruptive impact on data transport quantities as well as infrastructure needs and consequently, increase the energy demand on the macro level. Furthermore, new transportation models will have a higher impact on the macro level by decreasing energy demand from this sector.

The general trends of increased urbanization, growing population size of urban settlements, and the rise in the number of urban settlements, are expected to shift the energy demand on the meso level. A focus on the local food supply and car-free cities will have a decreasing impact on the energy demand, and can counter increased energy demands from growing urban populations. Particularly, the car-free city can have a disruptive impact because land use changes enable other strategies for decreasing energy demand like greening urban areas and fostering localized food systems.

Green Transition

The EU's green transition requires fairly intense initial energy requirements to build out new systems, infrastructure and capacities. Rebound effects of these efforts will have to be monitored closely and accounted for in other policies and financial instruments. The macro scale impact will initially be increased energy demands through increased (re)building of infrastructure to achieve the transition, with reduced energy demand over the long term. Net zero policies do not necessitate reduced energy demand, if ample emissions free energy sources can be tapped and upfront energy costs can be accounted for over time. Nevertheless, improving energy efficiency (including the objectives aimed at decreasing energy demand compared to the PRIMES reference scenario) is one of the main policies directions (see for example the Energy Efficiency Directive and the Energy Efficiency First principle implemented therein). EU regulatory power will play a strong role in shaping the different impacts of the green transition at meso and micro scales – though the same initial energy increases are likely if no incentives are set in place to counteract this development.

Decentralized Work

The digitalization of many forms of work is seen as having the highest impact on energy demand and is operating at a macro scale (supranational or global). Data centers are at the core of this energy demand growth, and they are impacted by limits of efficiency gains – an exponential growth of data use creates significant new energy demand.

Decentralized work also impacts energy demand in transportation systems and domestic lives, as people engage in work from home (initially energy intensive with slow reduction in energy demand), and move outside of city centers – increasing commute time, but reducing the frequency of work-related travel. The net effects of which are yet uncertain.

Finally, multigenerational living arrangements to save costs (including reduced energy demand), may also impact healthy aging and reducing energy demand from people who might be isolated (elderly or people with restrictions, etc.). Health care energy demands might also be reduced by fostering trans-generational living communities.

From Owning to Sharing

The disruption of ownership models has a high impact on energy demand, but operates at the micro scale. In particular, it decreases energy demand in the material extraction, production and transportation. Fewer "things" (tools, cars, equipment, etc.) with less idle time lead to a more efficient use of material and human resources.

Open access of knowledge was an important part of this cluster, including the move to all digital publications, open-source software and standards, and creative commons products. Overall open knowledge was seen as a reduction of energy demand – fewer material inputs for publishing, fewer systemic costs and demands for OSSS and Creative Commons (CC). However, in some cases, CC models for 3D printing for example, the open access could create an influx of individual production with accompanying material and energy costs increases.

The concept of shared living spaces (community kitchens for example) was a participant-generated topic that also led to questions regarding links between social and personal health as related to energy demand – do people who participate in healthier activities (cycling, sharing meals) require more or less energy in the rituals and routines?

Climate Change and Behavior

The activities and behaviors of individual consumers play an important role in shaping future energy demand. These behaviors can be shaped by strong national policy that incentivize decisions and actions that reduce various types of systemic energy demand (extraction, production, transport, domestic use, etc.). High impact can be expected at the micro scale.

Strong regional governance can also shape future generations from an earlier age with concerted education programs, creating social rewards for responsible consumption, and shaping perception of climate and energy sensitive behavior and attitudes. High impact can be expected at the meso scale.

Supranational and global compacts to address climate change (and affect energy demand) also encourage large-scale social reorientation – if those compacts are viewed as potent and reliable. Medium impact can be expected at the macro scale.

Circular Economy

This cluster of factors and trends was not one of those created in the workshop series, and, therefore, was not subject to the assessment matrix workshop.

The transition to a circular economy implies numerous systemic changes to socio-economic structures and industrial operations and processes. While circular economy

is often reduced to recycling, it also includes reduction and reuse. The former implies significant energy inputs and a likely rise in energy demand in the near term. In contrast, the latter two can potentially reduce energy demand and associated emissions.

These initial energy inputs for recycling could come in the form of designing, testing, implementing and scaling new systems of production, reclamation, recycling and repurposing. This includes new or restructured transportation systems of materials and products, construction of new facilities and machines for various operations, and other initial needs for systemic change.

However, if the circular model includes the material reduction and reuse, and defines the majority of recycling systems within a social, economic and industrial context, energy demands are expected to decrease, given the new material efficiencies. The energy efficiency promise of the circular economy, in combination with lowered emissions and decreased environmental impacts, is a major driving force in the model's adoption by policy-makers pushing for its implementation.

2) "Nice to have" trend clusters

Socio-Economic Dynamics (Toward Energy Equality)

There are a number of areas in which deepening inequalities are spurring momentum for societal shifts. The COVID-19 pandemic has highlighted the varying capabilities of healthcare systems across the EU, and simultaneously underscored the economic disparities that exist between member states and regions within each state. These are just two contemporary examples of how **social inequalities** can redirect investments and development – both of which imply short term increases in energy demand for infrastructure, increased operational capacities, and additional services. While addressing some of these inequalities may eventually lower energy demand through optimizing people's health or access to more energy efficient lifestyles – these energy gains may be a long time in coming.

Rebound effects must be considered for many of the proposed socio-technological solutions to address GHG emissions, resource intensive food and products, and other efforts to create a "green society" through economic stimulus and incentives. Rebound effects are when (energy) savings generated through a change in one aspect of a system initiate increases in energy demand in other parts of the system that lead to demands similar to initial conditions (or sometimes worse). For example, implementing more energy efficient technologies, or systems that encourage more energy aware behaviors, in search of solutions to address **energy poverty**, might in turn increase utilization of the newer more efficient technology – increasing overall energy usage. This is not to say that addressing energy poverty will inevitably lead to increased energy demand, but that direct and indirect rebound effects of all kinds should be taken into account, as soon as they can be anticipated.

The **rising middle class** is where we can see important dynamics playing out in concert. On one hand, rising middle class signals more affluence, and (hopefully) less socio-economic inequality. This is to be applauded, if it also signals that others are being raised out of poverty and other dire circumstances. However, one effect of a growing middle class is an increase in disposable income, which often signals increases in consumption, and inherent increases in energy demand (somewhere along the value chain of goods and services). Middle class growth in much of the developing world was showing signs of acceleration prior to the COVID-19 pandemic, and should be anticipated to begin again, as economies begin recovery processes.

Water Issues

Water is intractably linked to every aspect of human living – from direct consumption, to food production, to its hygienic necessity, to its use in various modes of energy production (as a medium, coolant, and water flow as a source of power). Its integrated nature across so many human systems amplifies the effects of disruptions to water sources – low rainfall, draughts, floods, urbanization and pollution, among others. The disruptions can generate increases in energy demand working at many scales but become more obvious at the meso level, when a region or nation experiences a significant (often prolonged) shift in water availability. When more overall energy is needed to extract and transport water from one source to cover shortages in another, this can add up very quickly.

Water scarcity can also directly and indirectly create larger numbers of refugees, displaced peoples and migrants – which in turn shifts energy demands (often across borders or rural/urban dividing lines). Additionally, middle class lifestyles are increasingly water (and thus energy) intensive, and the global middle classes grow, so too does water/energy/food demand increase.

Green Finance

Financing transition (financial systems) is going to be one of the main drivers to energy efficiency and electrification of services at macro level, decreasing or shifting energy demand between fossil fuel to electricity in the transport and other sectors. At the same time, at micro level, increasing recognition of climate risks among private sector actors (e.g. Task Force on Climate-related Financial Disclosures (TCFD)) may also foster decrease of final energy demand.

Crowdfunding established as an alternative financing model, as well as ethical and value-based financial services, may also decrease energy consumption at macro, meso and micro level. The impact of ethical financial services was assessed as low, because it is hardly seen in any scenario.

Citizen perceptions of environmental impacts of behaviors, which are closely related to the personal footprint (more responsible consumption) issues, together may decrease energy demand at micro level. Citizens are willing to be part of the transition but they face significant barriers. It may be barriers in financial sector, political ones, as well as the lack of trust in the institutions.

Demographic Change

Some regions in the world still see population growth, with a demographic phenomenon called a “youth bulge” – a statistically significant concentration of overall population being under the age of 25. Currently, there are nearly 3 billion humans on earth that fit into this definition of youth, with developing nations harboring this trend to a greater extent than more wealthy nations. This cluster could have a particularly strong impact on increasing energy demand within those regions where the youth bulge is most prominent (large parts of Africa, some nations in the Middle East, SE Asia, and South and Central America). Where regions are able to meet the increasing demand, there will be energy inputs into energy system buildouts (infrastructure, etc.) as well as continuous energy demand. In regions that are not able to meet energy demands, youthful populations may have more incentive to migrate in search of locations that can meet their demands – shifting increase from one region to another. Overall, this cluster may have a macro level increase in energy demand, though its meso level impacts will be pronounced in some areas.

Displacements are happening at global and regional level, and could also be affecting the energy demand at both scales. Although migrations can be caused by several reasons (working opportunities, climate, conflicts, social mobility), they are all considered to result in a moderate increase in the energy consumption. Increasing water scarcity as one stimulus for migrations is seen to have the highest impact on energy demand at a macro level. Migrating might also have an effect on the specific energy demand, e.g. migration from poor infrastructure with higher specific energy demand to the more developed infrastructure and vice versa. Among the trends attributed to this cluster, solidarity is considered to have a minor positive effect on energy demand, although depending on the definition, it might have a higher impact. If we consider the role of the young generation in learning new communication and solidarity skills, we can see a great impact on energy consumption.

Aging populations in the Global North could have a medium impact on energy demand at the supranational or global scale, depending on the energy intensity of the activities that older populations engage in and their overall physical health. While the impact manifests at a large scale, the size of the impact will rely on meso and micro factors – community (and infrastructure) design for aging populations and their needs, personal wealth, social factors that affect the activities people engage. The growth of the global health market – one way that healthy aging might be approached – will almost certainly increase energy demand. At the global scale, and at the meso scale, various types of health system development require infrastructure, technological investments, and rely on stable and redundant energy sources. Depending on how these newer systems are designed, the initial energy demands might be later recouped, but that is contingent on mesoscale policy decisions. The digitalization of health systems is another strong driver of future energy demand produced by healthcare system growth in response to aging populations.

3) "Optional" trend clusters

Geopolitics and Global Forces[4]

Geopolitical developments can have major impacts on the EU energy system and the future energy demand. The trends are operating mostly at a macro scale and mainly either increase the energy demand or shift the consumption between sectors. Factors included among many others:

- The fuel dependency of the EU can play a major role in the future development of the energy demand and the energy sources selected.
- The increase in the global population and in the middle class in BRICS states is considered to have a high increasing impact on energy demand.
- The relations between the Global North and South as well as the technological confrontation of US and China.
- Social disparities have a similar, but stronger impact on energy consumption.

4 Please note, that this work was performed well before the outbreak of the current war of aggression from Russia towards the Ukraine. In the light of the current development, the new societal trend on "Geopolitics and Global Forces" has gained major importance. Within this project, we are currently identifying ways how this trend can meaningfully be picked up into the project logic and how energy demand models have to be enhanced to be able to model a low-demand / low-gas energy scenario.

Great Depression II

This cluster, consisting of different aspects in relation to migration, such as the rising financial burden of industrial countries and social disparities on global level, is expected to be effective on the meso- and the macro-scale (similar to the cluster "Migration"). Based on the typically increasing life standards following migration, this impact will potentially increase the energy demand.

Depending on the impacts of the depression on the global economy, there may be a decrease in total energy demand (fewer goods, less disposable income). However, longer-term energy impacts might see an overall increase in energy demand as national and regional entities attempt to restart economies with inefficient experiments and large infrastructure build outs.

New Labor

In this cluster, relevant trends for the development of labor are covered. Eye-catching is on the one hand the necessity of new competences for working and on the other hand the increasing societal relevance of working.

The lack of skilled workers is becoming increasingly relevant. On one hand, many new competences are needed in the economy as a whole and in the energy sector in particular. One reason for this development is the increasing importance of digital skills in all areas, including in trades, such as heating installers, which play a crucial role in the transition process. New forms of job trainings as well as incentives are needed to transform the skill set of workers. On the other hand, there is a general shortage of skilled workers needed e.g. to perform thermal insulation of buildings. Much effort is needed to address both: sharpening the skill set and increasing the number of workers in these areas.

Furthermore, the societal relevance of work is mirrored in the factors covering the general aspect of job and market losses and the resulting factors covering loss of trust in government and populism. Those factors will have an impact on the macro scale and can potentially have a high impact on the energy demand depending on the new political agenda.

4) “Future Research” trend clusters

Evolving Democratic System

EU regulatory power and massive investment in green transition may have a high impact at macro level, decreasing energy demand in different sectors.

At the same time, at macro level, such trends as right-wing populism and the denial of equal rights, as well as populism and nationalism, may increase energy demand significantly (also a high impact).

Rising global burden of disease as a complex issue closely connected with aging population, may decrease energy demand, as people are on average going to consume more energy at home than at work or while traveling. These may lead to the need to have more care-givers and this would impact the health system as a whole. The impact on energy demand might be relatively small. At the same time, a growing share of healthy share of retirees might lead to more travel activities than in younger generations, which may increase energy demand or shift it to other sectors.

Loss of trust in government and media may significantly increase energy demand at meso and micro level. This will not trigger investments, so people will not reduce their

energy consumption as much as needed. On the contrary, active citizen participation may decrease energy demand at meso level.

3.4 Analysis of interrelationships between trends

Understanding the interrelations between new societal trends is crucial for enhancing the energy demand models to address these trends individually as well as in an integrated manner. Such connections between new social trends from different sectors can be revealed to see the complete picture of their joint influence on future energy demand in the European countries. The wealth of information that was provided in the first two workshops regarding the underlying factors that compose each new societal trend, allows for such an analysis.

We apply a network analysis to analyze and visualize interrelationships between new societal trends influencing future energy demand, which allows to see the general picture of connections between new societal trends and thus provides information about how new societal trends have to be considered and modeled in an integrated manner to account for their interdependencies. This informs the modeling discussion and enhancement of the project and is discussed in particular in Deliverable 3.1 on "Pathways for New Societal Trends and gap analysis for demand models" (Yu et al., 2021).

Figure 13 presents the network of new societal trends.[5] We recall that each of these trends is a cluster of several of the 241 factors identified before and during the first expert workshop. The network visualizes how many underlying factors the clusters have in common.

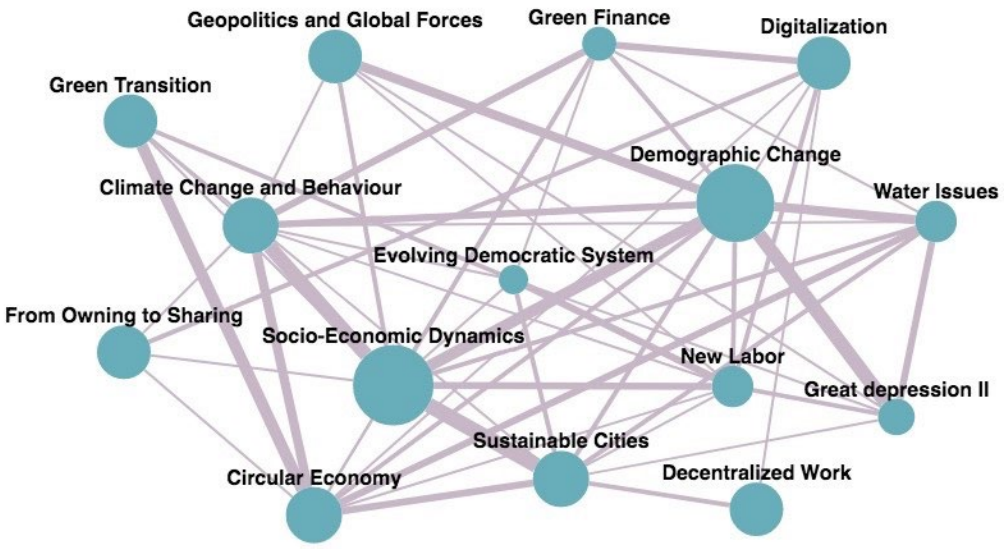
To recall, the following three clusters were merged:

- ***Sustainable cities*** (including “Sustainable cities” and “Urbanization”),
- ***Socio-Economic Dynamics (Toward Energy Equality)*** (including “Energy Poverty”, “Socio-Economic Equality”, “Rebound Effects” and “Growing Middle Class”),
- ***Demographic Change*** (including “Healthy Aging”, “Growing Youthful Population” and “Migration and Displacement”).

Another completely new cluster ***Circular Economy*** was created and described during the expert discussion in the third workshop, leading to a total of 15 new societal trends to be considered in the network analysis.

5 The network was created by the authors using the Graphonline software (www.graphonline.ru).

Figure 13: The network of new societal trends



The more underlying factors two of the trends have in common, the stronger is the link between them visualized. For example, there were six factors, which are part of the "Socio-Economic Dynamics" as well as the "Climate Change and Behavior" cluster:

1. Personal footprint – more responsible consumption.
2. Citizen perceptions of environmental impacts of behaviors.
3. Education and training options (sustainable development).
4. Slow consumption as a countertrend to fast fashion.
5. A new culture of exchange is becoming established.
6. Unconditional basic income.

The size of the node does hereby not represent its overall importance, but its interconnectedness. The larger the node of a trend is depicted, the more it is connected through factors to other trends.

This information on the connections between the trends can be considered in the following work packages, when modelers evaluate to which extent the different new societal trends that they consider in their model (enhancement) are interlinked.

In the following tables (tables 5-12), we present in more detail the dyads of new societal trends which share more than three underlying factors. It is important to emphasize that the common underlying factors are only the findings from the workshop discussions, so they may not be all-encompassing and should, therefore, be considered as starting points for future research.

Table 5: Connections between the "Socio-Economic Dynamics" and the "Sustainable Cities" clusters

Cluster A	Cluster B
Socio-Economic Dynamics	Sustainable Cities

Cluster A	Cluster B
6 common factors: • Rise in the number of urban settlements • Increasing land area of cities • The global urban middle class – tipping the scales of sustainable urban development? • Car-free cities • New cities without the necessity of a car • Citizen science – new challenges for science and society	
Description: Increasing urbanization and the growth of the middle class, particularly in underdeveloped areas, fuels the construction of new urban and suburban settlements. This provides an important leverage to construct these new areas in a sustainable manner (including but not limited to the areas of energy, materials and mobility). Due to energy inequalities, people having fewer means to travel to their workplace may suffer from social isolation and vulnerability. The concept of a "car-free city", with more efficient public transport, better cycling infrastructure, car-sharing options, etc., may help local governments tackle or mitigate transport poverty in urban areas. Due to an increasing number of challenges and increased digitalization of the general public, "citizen science", which implies involvement of urban dwellers in data collection or analysis for research projects, may be beneficial for the future development of the cities based on the needs and actual behavior of the citizens and thus benefitting society as a whole.	

Table 6: Connections between the "Socio-Economic Dynamics" and the "Climate Change and Behavior" clusters

Cluster A	Cluster B
Socio-Economic Dynamics	Climate Change and Behavior
6 common factors: • Personal footprint – more responsible consumption • Citizen perceptions of environmental impacts of behaviors • Education and training options (sustainable development) • Slow consumption as a countertrend to fast fashion • A new culture of exchange is becoming established • Unconditional basic income	
Description: Addressing climate change needs to be done in an all-encompassing manner. On one hand, the systems in which we operate have to change (e.g. how energy is generated, how mobility and cities are designed in a sustainable manner). On the other hand, individual behavior plays an important role within these changing systems as well. The connections between these two clusters are heavily oriented toward the role of the individual and community/cultural conditions. These connections, therefore, emphasize the role of changing behavior. This does not undermine the role of systemic and technical change and technical innovations, but (given that they are an essential part of all energy demand modeling activities) they are not in the center of the observation between the two new societal trends here.	

Table 7: Connections between the "Demographic Change" and the "Great Depression II" clusters

Cluster A	Cluster B
Demographic Change	Great Depression II
6 common factors: • Increasing global migration • Migration and displacement • Refugees from conflict or persecution • Climate refugees • Migration for social mobility • Social disparities – fault lines of global development	
Description: The economic uncertainty that the COVID-19 pandemic has caused continues to manifest in future-oriented concerns about "Great Depression II" (both within and external to the EU) and its impact on migration. The factors show, however, that migration for social mobility is only one of many reasons for cross-country mobility, which is fostered not last by the impacts of climate change as well as ongoing conflicts and war. Energy demand in the EU will increase as population does, which can easily be seen from current energy demand modeling activities and their sensitivity to population projections. However, there are some non-linear aspects to this increased energy demand, as migrants will be an assemblage of cultures, practices, and behaviors from around the world.	

Table 8: Connections between "Socio-Economic Dynamics" and "Demographic Change" clusters

Cluster A	Cluster B
Socio-Economic Dynamics	Demographic Change
5 common factors: • Citizen perceptions of environmental impacts of behaviors • Education and training options • Social innovation (EU) • Growing share of middle class in BRICS states • Solidarity	
Description: Both of these more encompassing clusters were created as a result of merging previously existing clusters in the final third workshop. The EU has been an aging population for decades, implying that youthful populations are coming from outside of the EU. The main connection outlined here is future energy demand as a result of learning and awareness raising, particularly with respect to individual and community behavior and practice. It is worth noting that youthful populations are also seen as a source of social innovations and solidarity – a wealth of ideas that might be focused on climate related community behavior.	

Table 9: Connections between the "Demographic Change" and the "Water Issues" clusters

Cluster A	Cluster B
Demographic Change	Water Issues
4 common factors: • Increasing water scarcity • Migration and displacement • Refugees from conflict or persecution • Climate refugees	
Description: Similar to the above, the trends that connect these clusters outline how "Water Issues" can drive "Migration and Displacement", but also how migration can drive water scarcity (for example through urbanization). The relationship between water, population, and energy demand is the critical aspect to account for, particularly with changes in water availability and energy intensive practices to create save water (e.g. through desalinization).	

Table 10: Connections between the "Demographic Change" and the "Geopolitics and Global Forces" clusters

Cluster A	Cluster B
Demographic Change	Geopolitics and Global Forces
4 common factors: • Social disparities – fault lines of global development • Growing share of middle class in BRICS states • Increase in population globally • Shift of (geopolitical) power (East and South)	
Description: The relationship outlined between these two clusters points toward the shift in global wealth and power that the 21st century is expected to witness. "Demographic change", when viewed as a geopolitical force, could impact energy systems and markets in the EU. Above we outlined how youthful populations might migrate to the EU, but we must also consider those populations that devote their energies and abilities to the construction of energy systems within their home communities. Modeling the rising energy demand external to the EU, the competition for the most skilled workers and its systemic effects within the EU, could be valuable additions to energy demand models.	

Table 11: Connections between "Green Transition" and "Circular Economy" clusters

Cluster A	Cluster B
Green Transition	Circular Economy
4 common factors:	

Cluster A	Cluster B
• Massive investment in green transition • Rebound effect: underestimated paradox of sustainability policy • Net zero policies • EU regulatory power	

Description:

The European Commission's new Circular Economy Action Plan (CEAP) adopted in March 2020 is one of the main building blocks of the European Green Deal 2050. Circular economy implies using new emerging business models and operations as well as novel concepts of production and consumption. Massive investment in circular economy aims at reducing pressure on natural resources and creating sustainable growth and jobs. The EU regulatory policy is needed to achieve the EU's 2050 climate neutrality target and stop biodiversity loss.

Table 12: Connections between "Climate Change and Behavior" and "Circular Economy" clusters

Cluster A	Cluster B
Climate Change and Behavior	Circular Economy
4 common factors: • Education and training options • Personal footprint – more responsible consumption • Citizen perceptions of environmental impacts of behaviors • Slow consumption as a countertrend to fast fashion	

Description:

Circular economy requires a fundamental change in the way people produce and consume. A circular approach reduces emissions and pollution, increases competitiveness, and boosts innovation – therefore, making economy and society more sustainable and resilient in the long run. Citizen perceptions of environmental impacts and more responsible consumption, supported by education and training options, can be considered as the key factors contributing to the transition to a circular economy from the citizen perspective.

4. Conclusion

Taking into account substantial and potentially disruptive impacts of new societal trends (such as circular and shared economy, digitalization of economic and private life, prosumaging etc.) on future energy demand, the main goal of this research was to identify the most relevant new societal trends that may influence the European future energy demand in different areas. Additionally, we assessed if it is already foreseeable which kind of impact these trends might have on the future energy demand (increasing, decreasing or shifting to other sectors). The identified trends and the initial assessment are then taken forward to the considerations in the following work packages and inform the model enhancements as well as the further scenario development.

This research was conducted in three methodological steps. First, energy relevant factors were selected based on an analysis of previous foresight studies and long-term energy demand scenarios. Second, in three expert workshops the factors were clustered and their potential importance and disruptiveness was assessed using the three-dimensional metrics (impact degree, impact scale, impact direction). As a result, 20 new societal trend candidates (clusters of factors) were developed, out of which a final list of 15 new societal trends was created. The new societal trends were classified into four categories: “Universal” (7 trends), “Nice to have” (4 trends), “Optional” (3 trends) and “Future research” (1 trend). In addition, the narratives for the resulting 15 major new societal trends were developed to describe the potential mechanisms of their impact and disruptiveness for future energy demand.

The analysis has shown that the resulting new societal trends and their underlying factors have a controversial impact on future energy demand (simultaneously decreasing, increasing or shifting to other sectors) and are therefore crucial to be studied in detail to assess their final contribution to the energy transition. The findings from this deliverable highlight the importance of taking additional matters, such as disruptiveness of trends, uncertainties related to trends, cross-impact and cross-sectoral analysis, as well as associated policy measures, into account when modeling future energy demand. This informs the remainder of the project and is next picked up by our Deliverable 3.1. "Pathways for New Societal Trends and gap analysis for demand models" (Yu et al, 2021).

As the newTRENDs project goes forward, it now has a clear formulation of the types of trends to be assessed for integrating into the energy demand models. What became apparent from many of our expert interactions is that some of the new societal trends identified within the workshop series are already well known and have been the focus of previous modeling research. “Demographic Change” and “Sustainable Cities”, for instance, are two such trend clusters that have dedicated long-running quantitative research communities. To what degree those efforts are established as central to defining and projecting future energy demand, remains to be explored.

We believe that novel clusters, which are currently not or only minimally considered in energy demand scenarios, have also emerged from WP2 – in particular concerning the impact that the clusters “Decentralized Work”, “Water issues”, “Green Finance” and “Migration” will have on energy demand.

The results presented in this deliverable build the basis for the upcoming work in the project, where the identified new societal trends and their narratives will inform the

enhancement of our energy demand models, which are frequently used to model European long-term scenarios. Furthermore, the narratives will contribute to the scenario development and the cross-sectoral modeling of the trends. This will lead to a better understanding of potential non-linear developments of future energy demand and of how energy (efficiency) policies could be designed to take these trends meaningfully into account.

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A.1 Annex

A.1.1 The clusters and their underlying trends

Table 13: The clusters and their underlying trends

New Societal Trend Candidates (Clusters of factors)	Underlying factors
Digitalization: New challenges and requirements of the progressing digitalization.	The digital dimension
	Reindustrialization
	Rise of digital traffic
	Trust in the Internet age
	Data economy readiness
	E-government to foster transparency
	Governance of new technologies
	Acceleration of virtual work (COVID-19)
	Open access – knowledge freely available and free of charge for all
	Increasing demands for the right to use digital goods for free
	Global crypto-currency markets
	Digital currencies gaining in variety
	Giving up cash
	Digital competency pressure as a social organizational task
	Digital literacy and skills
	Digital technology business models
	Production practices
	Disruption of ownership models
	Corporate gamification
	Green ICT (case study)
Sustainable Cities: The development of urban living spaces to meet future challenges.	Population size of urban settlements
	Rise in the number of urban settlements
	Increased urbanization
	Increasing land area of cities
	Urban governance – solving global challenges locally in cities
	The global urban middle class – tipping the scales of sustainable urban development?
	Local food circles
	Localized food systems

New Societal Trend Candidates (Clusters of factors)	Underlying factors
	Car-free city
	New transport models (hubs)
	New cities without the necessity of a car
	Transportation systems
	Community gardening
	Reconquering the public space
	Hyper-connectivity
	Greening urban areas
Green Transition: Determining an appropriate policy mix for relevant challenges.	Massive investment in green transition
	Noise: the ignored environmental and health problem
	Rebound effect: underestimated paradox of sustainability policy
	Net zero policies
	EU regulatory power
Decentralized Work: Remote working allow workers to operate from anywhere.	Changes in the nature of work (increasing importance of service sector and knowledge work)
	The digital dimension
	Transportation systems
	Family structure
Climate Change and Behavior: Increasing climate change concerns requiring changing consumer behavior.	Climate change: 36% CO_2 increase by 2035 (without counter-measures)
	Education and training options
	Personal footprint – more responsible consumption
	Ethical and value-based financial services
	"Don't tread on me" response to government policies
	Citizen perceptions of environmental impacts of behaviors
	EU regulatory power
	Basic income
	Green Deal (EU)
	Increase in diversity of actors in and forms of education
	Slow consumption as a countertrend to fast fashion
	Unreliable emissions commitments (US)
	Returns on state investment in education

New Societal Trend Candidates (Clusters of factors)	Underlying factors
	A new culture of exchange is becoming established
	Dependence on natural resources
From Owning to Sharing: The growing sharing culture enables innovative ideas in exchange of knowledge and promotes sharing platforms.	A new culture of exchange is becoming established
	Online and offline sharing communities
	Disruption of ownership models
	Collaborative innovation spaces
	Open access – knowledge freely available and free of charge for all
Energy Poverty: Energy poverty and inequalities caused by rising energy prices.	Personal footprint – more responsible consumption
	Rising energy prices
	New cities without the necessity of a car
	Car-free city
	Inequalities worsening
Socio-Economic Equality: Ensuring equality in providing basic needs (basic income, health coverage, etc.).	Unconditional minimum basic income
	The gender pay gap
	National referendum on unconditional basic income
	Universal health coverage
	Solidarity
	Social cohesion – the cement of 21st-century societies?
	Privatization of public services
	Basic income
Water Issues: Increasing water scarcity effects multiple aspects of society.	Regional instabilities
	Increasing water scarcity
	Migration and displacement
	Green electricity is needed, but increasing water scarcity (conflict) impacts energy supply
	Localized food systems
	Personal footprint – more responsible consumption
	Refugees from conflict or persecution
	Migration
	Food and water
	Issuing permits
	Emergence and growth of a global middle class

New Societal Trend Candidates (Clusters of factors)	Underlying factors
	Destabilized regions (electricity supply)
	Green energy colonialism (EU)
	Climate refugees
	Agricultural practices
	Diversification (EU)
	Security of supply (EU)
Healthy Aging: Increasing life expectancy and aging workforce in Global North due to advances in digital healthcare.	Aging populations (Global North)
	Healthcare as related to the SDGs
	Growth of the global health market
	Psychological health
	Aging workforce
	Advances in digital healthcare
	The battle against obesity is intensifying
	Increased 65-plus age and increase in life expectancy
	New senior citizens are shaping protest culture
	Owning and sharing health data
Urbanization: Changing perceptions of inequalities caused by the rural and urban divide.	Increased urbanization
	Changes in rural and urban areas
	Fewer rural areas, more commuting, green urban planning, governing new urbanites
	Urban-rural divide in US is also a political divide, policy and perception driven
	Infrastructure builds out difficulties (US)
	The growing importance of the region in the global economy
	Citizen science – new challenges for science and society
	Skyscrapers and buildings that have potential for future ghettoization (EU)
	Massive investment in green transition
	Rise in the number of urban settlements
	Population size of urban settlements
	Increased mobility
	Managing migration
	Greening urban areas
	Community gardening
	Transportation systems

New Societal Trend Candidates (Clusters of factors)	Underlying factors
	New cities without the necessity of a car
	Localized food systems
Green Finance: Increasing recognition of behavioral impact leading to new financial services.	Financial system
	Financing transition
	Development scenarios for the global financial system
	Emerging governance framework in the area of sustainable finance (EU, Asia, US)
	Ethical and value-based financial services
	Click to protest – more activities through organization in the Internet?
	New senior citizens are shaping protest culture
	Citizen perceptions of environmental impacts of behaviors
	Personal footprint – more responsible consumption
	Pressure from society on financial services and businesses
	Giving up cash
	Alternative currencies
	Digital currencies gaining in variety
	Global crypto-currency markets
	Increasing recognition of climate risks among private sector actors (e.g. Task Force on Climate-related Financial Disclosures (TCFD))
	Devestment
	Crowdfunding is becoming established as an alternative financing model
	Financial system
	Financing transition
Growing Youthful Population: Growing population in Global South requiring sustainable education, high Internet coverage and social innovation.	The growing importance of the region in the global economy
	Concentrated youth populations (Global South)
	Education and training options
	Growing importance of enterprises in emerging economies
	Citizen perceptions of environmental impacts of behaviors
	Returns on state investment in education
	Economic activity in extreme climatic regions is being stepped up

New Societal Trend Candidates (Clusters of factors)	Underlying factors
	Social disparities – fault lines of global development
	Growing share of middle class in BRICS states
	Increase in population globally
	Social innovations (EU)
	Fridays for Future (EU)
	High Internet coverage
	US historical relationship with parts of global South (CA/SA) – colonization, exploitation (how does this impact energy systems?)
	Shift of (geopolitical) power (East and South)
	Green ICT (case study)
Great Depression II: Depression affecting the financial situation in the countries and increasing migrations.	Rising national debt in industrialized countries
	Social disparities – fault lines of global development
	Migration and displacement
	Refugees from conflict or persecution
	Climate refugees
	Managing migration
	Migration for social mobility
	Increasing global migration
Rebound Effect: Policy consequences detract from efficacy due to adaptation (market, consumer etc.).	Social innovations (EU)
	Building markets for sustainable products (EU)
	CEAP (EU)
	Fossil fuel and industrial power resistance (US based companies)
	Citizen science – new challenges for science and society
	Policy and behavior (e.g. buying 5 max efficiency TVs is not helping), restrictive policies
	Education and training options
	Slow consumption as a countertrend to fast fashion
	New requirements for material flows for consumer goods have a delayed impact on the environment and disposal systems
	Citizen perceptions of environmental impacts of behaviors
	Challenging established and traditional gatekeeper powers (resistance)

New Societal Trend Candidates (Clusters of factors)	Underlying factors
	Behavior of people, activities perceived as green increase
	A new culture of exchange in circular economy demands more transportation
	Unsustainable consumer patterns
	Rebound effect: underestimated paradox of sustainability
Geopolitics and Global Forces: Role of the geopolitical dimension in trade, social aspects, demand/supply sides.	Relation (Global North & South)
	Growing share of middle class in BRICS states
	The geopolitical dimension
	Inequalities worsening
	African innovations point to new paths for innovations
	Strong trade and investments
	Climate change: 36% CO2 increase by 2035 (without counter-measures)
	Increase in population globally
	Social disparities – fault lines of global development
	US/China technological confrontation
	Reliance on non-EU suppliers
	Shift of (geopolitical) power (East and South)
New Labor: Increasing relevance of labor for societal participation.	Inequalities worsening
	Labor markets and job losses
	Populism & Nationalism
	Partly skepticism on the usefulness of the EU
	Loss of trust in government
	Managing migration
	Increased migration to the cities
	Increasing global migration
	Unconditional minimum basic income
	Education and training options
	Reinventing education
	Digital literacy and skills
	Digital competency pressure as a social organizational task
Migration and Displacement:	Climate refugees
	Increasing global migration

New Societal Trend Candidates (Clusters of factors)	Underlying factors
Increasing global migration, which requires fair access to water and modern energy services.	The growing importance of the region in the global economy
	Increasing water scarcity
	Migration for social mobility
	Solidarity
	Refugees from conflict or persecution
	Migration for work and opportunities
Growing Middle Class: Growing urban middle class potentially contributing to sustainable urban development.	Emergence and growth of a global middle class
	Growing share of middle class in BRICS states
	The global urban middle class – tipping the scales of sustainable urban development?
	Unsustainable consumer patterns
	Increasing land area of cities
	Rise in the number of urban settlements
Evolving Democratic System: Political systems adapting to social platforms, data streams, changing demographics.	Managing migration
	Massive investment in green transition
	Populism & Nationalism
	Rising global burden of disease
	EU regulatory power
	Loss of trust in government
	Governance policies
	Citizen participation
	Loss of trust in media
	Click to protest – more activities through organization in the internet?
	Challenging established and traditional gatekeeper powers (resistance)
	Increased EU integration
	Right-wing populism and the denial of equal rights

A.1.2 Cluster impact assessment: degree, scale, direction

Table 14: Cluster impact assessment: degree, scale, direction

Cluster description	Initial trends	Selected trends (** = disruptive)	*Additional trends added by experts (related to initial trends / extra trends)	Impact degree (High / Medium / Low)	Impact scale (Macro / Meso / Micro)	Impact direction (Decreasing / Increasing / Shifting)	Additional context (narratives)
Priority clusters (top 10 selected by experts):							
*1. **Digitalization***	1. The digital dimension	The experts called this trend too broad.	-	-	-	-	-
New challenges and requirements of the progressing digitalization	2. Reindustrialization	***Reindustrialization***	-	High	Macro	Shifting	-
				Medium	Macro	Decreasing	Reindustrialization: bringing back the industrial sector will imply fulfilling the EU environment standards.
(20 initial trends) (14 votes)	3. Rise of digital traffic	***Rise of digital traffic***	-	High	Macro	Increasing	
[group 3]				Low	Macro	Shifting	Digital traffic may increase electrical energy consumption but it will mostly move from other actions (mostly fossil fuels related to the transport of good and services, travels and materials for "things").
	4. Trust in the Internet age	-	-	-	-	-	-
	5. Data economy readiness	-	-	-	-	-	-
	6. E-government to foster transparency	-	-	-	-	-	-
	7. Governance of new technologies	-	-	-	-	-	-

Cluster description	Initial trends	Selected trends (** = disruptive)	*Additional trends added by experts (related to initial trends / extra trends)	Impact degree (High / Medium / Low)	Impact scale (Macro / Meso / Micro)	Impact direction (Decreasing / Increasing / Shifting)	Additional context (narratives)
Priority clusters (top 10 selected by experts):							
	8. Acceleration of virtual work (COVID-19)	***Acceleration of virtual work (COVID-19)****	-	High	Macro	Decreasing	-
				Medium	Macro	Decreasing	-
				High	Micro	Decreasing	-
	9. Open access – knowledge freely available and free of charge for all	-	-	-	-	-	-
	10. Increasing demands for the right to use digital goods for free	-	-	-	-	-	-
	11. Global crypto-currency markets	***Currency issues***	-	-	-	-	-
	12. Digital currencies gaining in variety		-	-	-	-	-
	13. Giving up cash		-	-	-	-	-
	14. Digital competency pressure as a social organisational task	***Digital competency pressure as a social organizational task***	-	Low	Micro	Decreasing	-
	15. Digital literacy and skills	***Digital literacy and skills***	-	High	Macro	Decreasing	-
				Medium	Micro	Increasing	
				Medium	Micro	Increasing	
	16. Digital technology business models	***Digital technology business models****	-	-	-	-	-
	17. Production practices	-	-	-	-	-	-

Cluster description	Initial trends	Selected trends (** = disruptive)	*Additional trends added by experts (related to initial trends / extra trends)	Impact degree (High / Medium / Low)	Impact scale (Macro / Meso / Micro)	Impact direction (Decreasing / Increasing / Shifting)	Additional context (narratives)
Priority clusters (top 10 selected by experts):							
	18. Disruption of ownership models	***Disruption of ownership models****	-	High	Micro	Decreasing	-
	19. Corporate gamification	***Corporate gamification***	-	Low	Micro	Decreasing	-
	20. Green ICT (case study)	***Green ICT (case study)***	-	Low	Meso	Decreasing	-
2. Sustainable Cities *The development of urban living spaces to meet future challenges* (16 initial trends) (12 votes) [group 4]	1. Population size of urban settlements	***Population size of urban settlements***	-	Low	Meso	Shifting	-
	2. Rise in the number of urban settlements	***Rise in the number of urban settlements***	-	Medium	Meso	Shifting	-
	3. Increased urbanisation	***Increased urbanisation***	-	Medium	Macro	Decreasing	-
	4. Increasing land area of cities	***Increasing land area of cities***	-	Medium	Micro	Increasing	-
	5. Urban governance – solving global challenges locally in cities	***Urban governance – solving global challenges locally in cities***	-	Medium	Meso	Decreasing	-
	6. The global urban middle class – tipping the scales of sustainable urban development?	-	-	-	-	-	-
	7. Local food circles	***Local food circles***	-	Medium	Micro	Decreasing	-
	8. Localized food systems	***Localized food systems***	-	Medium	Micro	Decreasing	-
	9. Car-free city	*Car-free city**	-	Medium	Meso	Decreasing	Car-free city: allow cities to be "sustainable", making cities attractive (greening, local food, public space).

Cluster description	Initial trends	Selected trends (** = disruptive)	*Additional trends added by experts (related to initial trends / extra trends)	Impact degree (High / Medium / Low)	Impact scale (Macro / Meso / Micro)	Impact direction (Decreasing / Increasing / Shifting)	Additional context (narratives)
Priority clusters (top 10 selected by experts):							
	10. New transport models (hubs)	***New transport models (hubs)***	-	Medium	Macro	Decreasing	-
	11. New cities without the necessity of a car	***New cities without the necessity of a car***	-	Low	Meso	Decreasing	-
	12. Transportation systems	***Transportation systems***	TRANSPORTATION SYSTEMS:	High	Macro	Decreasing	-
			*Autonomous driving/ sharing cars or vehicles (not only for cities)	Medium	Meso	Increasing	-
	13. Community gardening	***Community gardening***	-	Low	Meso	Decreasing	-
	14. Reconquering the public space	***Reconquering the public space***	-	Low	Micro	Decreasing	-
	15. Hyper-connectivity	***Hyper-connectivity *****	-	High	Macro	Increasing	Hyper-connectivity (data transport globally, data amount change, data availability, consumption and production patterns) requires infrastructure changes.
	16. Greening urban areas	***Greening urban areas***	-	Low	Meso	Decreasing	-
*3. **Green Transition*** *Determining an appropriate policy mix for relevant challenges*	1. Massive investment in green transition	***Massive investment in green transition****	-	High	Macro	Decreasing	The European Green Deal Investment Plan aims to mobilise EU funding and create a framework to facilitate and stimulate the public and private investments for European green transition.

Cluster description	Initial trends	Selected trends (** = disruptive)	*Additional trends added by experts (related to initial trends / extra trends)	Impact degree (High / Medium / Low)	Impact scale (Macro / Meso / Micro)	Impact direction (Decreasing / Increasing / Shifting)	Additional context (narratives)
Priority clusters (top 10 selected by experts):							
(5 initial trends) (9 votes) [group 5 + additional assessment by internal experts]	2. Noise: the ignored environmental and health problem	***Noise: the ignored environmental and health problem***	-	Low	Meso	Decreasing	Noise could be utilised in producing energy (mechanical energy is transformed to green electric energy), especially in dense urban areas like big cities (f.e. can be used in street lighting).
	3. Rebound effect: underestimated paradox of sustainability policy	***Rebound effect: underestimated paradox of sustainability policy****	-	High	Macro	Increasing	Rebound effect may increase energy consumption due to environmental efficiency interventions: price induced rebound effects (i.e. an efficient product being cheaper and therefore more is consumed); or behavioral/psychological rebound effects (where a good perception of being "green" encourages increased consumption for certain products where "green" or lower impact options are readily available).
	4. "Net-zero" policies	***"Net-zero" policies***	-	High	Macro	Decreasing	In a 2018 special report, the IPCC stated that countries must bring carbon dioxide emissions to "net zero" by 2050 to keep global warming to within 1.5 ˚C of pre-industrial levels. "Net zero" means that any emissions are balanced by absorbing an

Cluster description	Initial trends	Selected trends (** = disruptive)	*Additional trends added by experts (related to initial trends / extra trends)	Impact degree (High / Medium / Low)	Impact scale (Macro / Meso / Micro)	Impact direction (Decreasing / Increasing / Shifting)	Additional context (narratives)
Priority clusters (top 10 selected by experts):							
							equivalent amount from the atmosphere.
	5. EU regulatory power	***EU regulatory power***	-	High	Meso	Decreasing	Large-scale transition of EU (with strong regulatory power on regional level) to become the world's first "climate-neutral bloc" by 2050.
				Medium	Micro Macro	Increasing	Individuals may protest against hard imposition of sustainable consumption patterns and express their personal freedom and individualism in decision-making. Small enterprises may protest against the EU green policy, complaining about increasing environmental protection requirements and falling product prices, which are increasingly damaging their business.
*4. **Decentralised Work*** *Remote working allows workers to operate from anywhere* (4 initial trends)	1. Changes in the nature of work (increasing importance of service sector and knowledge work)	-	-	-	-	-	-
	2. The digital dimension	***The digital dimension****	THE DIGITAL DIMENSION:	High	Macro	Increasing	-
			*Energy increase in data centers	High	Macro	Increasing	-

Cluster description	Initial trends	Selected trends (** = disruptive)	*Additional trends added by experts (related to initial trends / extra trends)	Impact degree (High / Medium / Low)	Impact scale (Macro / Meso / Micro)	Impact direction (Decreasing / Increasing / Shifting)	Additional context (narratives)
Priority clusters (top 10 selected by experts):							
(8 votes) [group 1]			*Experts see a break in the trends, exponential growth of data use	High	Macro	Increasing	-
			*Limits of efficiency gains	High	Macro	Increasing	-
			*Doubling the equipment (at office + at home)	Medium	Meso	Shifting	Decreasing impact: possible long-term energy decrease given less equipment changeover – resource demands, etc. Increasing impact: counter argument –higher technological turnover leads to increased energy demand.
			*Linked to non-urban living necessities	Medium	Meso	Increasing	-
			*Higher connection speed at home = major rebound effects	High	Micro	Increasing	-
	3. Transportation systems	***Transportation systems***	TRANSPORTATION SYSTEMS:	Low	Meso	Decreasing	Overall impact on energy demand is decrease (fewer conferences, business trips, major impact on transport).
			*More biking for short commuting	Low	Meso	Decreasing	-
			*Less congestion	Low	Meso	Decreasing	-
			*Shared office space	Low	Meso	Decreasing	-
			*Longer distance (looking for cheaper	Low	Meso	Increasing	-

Cluster description	Initial trends	Selected trends (** = disruptive)	*Additional trends added by experts (related to initial trends / extra trends)	Impact degree (High / Medium / Low)	Impact scale (Macro / Meso / Micro)	Impact direction (Decreasing / Increasing / Shifting)	Additional context (narratives)
Priority clusters (top 10 selected by experts):							
			housing, more away from office)				
			*Increased in car use for long commuting	Low	Meso	Increasing	-
	4. Family structure	***Family structure****	FAMILY STRUCTURE:	Medium	Micro	Increasing	-
			*Pandemic effect	Medium	Micro	Increasing	
			*Lower need in retirement houses, less energy needs here as well	Medium	Micro	Decreasing	-
			*Young people moving back home for cost efficiency	Medium	Micro	Decreasing	-
			*Is there a reversal a shift back to multi-generational households?	Medium	Micro	Decreasing	There is an increasing number of cities that are adopting and promoting this model. There are both community led and public efforts to promote this model. Swedish experiments in multi-generational living arrangements with some shared spaces.
			*Childcare / housework (unpaid labor) becoming more balanced sharing this workload	Medium	Micro	Shifting	-
			*The recognition of loneliness as a huge social condition.	Medium	Micro	Decreasing	Activities that bring us the most joy are often the least energy intensive.

Cluster description	Initial trends	Selected trends (** = disruptive)	*Additional trends added by experts (related to initial trends / extra trends)	Impact degree (High / Medium / Low)	Impact scale (Macro / Meso / Micro)	Impact direction (Decreasing / Increasing / Shifting)	Additional context (narratives)
Priority clusters (top 10 selected by experts):							
			What is the link between loneliness and energy demand?				
			*Restaurants (lunch options) are closed now using less energy	Low	Micro	Decreasing	-
			*High housing prices	-	-	-	Due to high prices, people taking advantage of home office look for housing in cheaper areas, more far away from their office (trend already clear in France in cities with high housing prices). So home office might turn into local shared offices. But it means also cheaper office prices, so more area per employee? This trend is usually related to areas with high share of jobs in services. So far, offices stay in areas close to train stations etc., so are expensive in price per m2.
*5. **From Owning to Sharing*** *The growing sharing culture*	1. A new culture of exchange is becoming established	***A new culture of exchange is becoming established****	A NEW CULTURE OF EXCHANGE:	High	Micro	Decreasing	-
			*Urban and rural sharing systems	High	Micro	Decreasing	-
			*Honesty boxes	High	Micro	Decreasing	-

Cluster description	Initial trends	Selected trends (** = disruptive)	*Additional trends added by experts (related to initial trends / extra trends)	Impact degree (High / Medium / Low)	Impact scale (Macro / Meso / Micro)	Impact direction (Decreasing / Increasing / Shifting)	Additional context (narratives)
Priority clusters (top 10 selected by experts):							
enables innovative ideas in exchange of knowledge and promotes sharing platforms (5 initial trends) (7 votes) [group 1]	2. Online and offline sharing communities	***Online and offline sharing communities***	ONLINE AND OFFLINE SHARING COMMUNITIES:	High	Micro	Decreasing	-
			*Urban planning and energy demand in buildings	High	Micro	Decreasing	-
			*Parking space for bike parking or sharing	High	Micro	Decreasing	What is the link between health and energy demand?
			*Sharing physical objects (tools, etc.)	High	Micro	Decreasing	Are there research projects examining connections between health (and healthy behaviors) and energy demand?
			*Sharing physical spaces (e.g. more cycle friendly)	High	Micro	Decreasing	Are there research projects examining health (and healthy behaviors) with energy demand?
			*Uber and other sharing models				
	3. Disruption of ownership models	***Disruption of ownership models***	DISTRIBUTION OF OWNERSHIP MODELS:	High	Micro	Decreasing	-
			*Increasing bike ownership	High	Micro	Decreasing	What is the link between health and energy demand?
	4. Collaborative innovation spaces	***Collaborative innovation spaces***	COLLABORATIVE INNOVATION SPACES:	Low	Macro	Decreasing	-
			*3D-printing	Low	Macro	Decreasing	Decreasing energy demand: 3D-printing and distributed manufacturing. Increasing energy demand: possible rebound effect – 3D-printing becomes much more

Cluster description	Initial trends	Selected trends (** = disruptive)	*Additional trends added by experts (related to initial trends / extra trends)	Impact degree (High / Medium / Low)	Impact scale (Macro / Meso / Micro)	Impact direction (Decreasing / Increasing / Shifting)	Additional context (narratives)
Priority clusters (top 10 selected by experts):							
							common, so there will a lot more demand for material inputs.
			*Repairing culture – longer life spans for equipment (repurpose, upgrade)	Low	Macro	Decreasing	-
	5. Open access – knowledge freely available and free of charge for all	***Open access – knowledge freely available and free of charge for all****	OPEN ACCESS	Low	Macro	Decreasing	-
			*Open source software / hardware	Low	Macro	Decreasing	-
			*Digitalization of knowledge: move from physical to electronic publications (already a mature trend)	Low	Macro	Decreasing	Increasing energy demand: more articles means more printing of articles. Decreasing energy demand: home office might counter this (when printing costs are individualised, there is less printing).
			*Increase awareness of energy inputs (more conscious consumption)	Low	Macro	Decreasing	-
			*Less duplication of work	Medium	Meso	Decreasing	-
			*More efficient use of resources	Medium	Meso	Decreasing	-
6. Climate Change and Behavior	1. Climate change: 36% CO_2 increase by 2035 (without counter-measures)	***Social acceptance of the climate change goals****	-	Medium	Macro Meso Micro	Decreasing	Energy consumption may significantly decrease if the majority of consumers agree to actively change their habits towards green transition.
	2. Green Deal (EU)						

Cluster description	Initial trends	Selected trends (** = disruptive)	*Additional trends added by experts (related to initial trends / extra trends)	Impact degree (High / Medium / Low)	Impact scale (Macro / Meso / Micro)	Impact direction (Decreasing / Increasing / Shifting)	Additional context (narratives)
Priority clusters (top 10 selected by experts):							
Increasing climate change concerns requiring changing consumer behavior (15 initial trends) (7 votes) [group 1 + additional assessment by internal experts]	3. EU regulatory power 4. Unreliable emissions commitments (US)			Medium	Macro Meso Micro	Increasing	In case of many protests and demonstrations against the new green requirements, energy consumption may increase.
	5. Education and training options 6. Increase in diversity of actors in and forms of education 7. Returns on state investment in education	***Sustainability education and training options****	-	Medium	Macro	Decreasing	Sustainability education on macro level (climate change, environmental degradation, loss of biodiversity, poverty and inequality) should allow making informed decisions and taking individual and collective action to change society on the way to green transition (leads to decreasing energy demand).
	8. Personal footprint – more responsible consumption 9. Citizen perceptions of 'environmental impacts of behaviors 10. Slow consumption as a countertrend to fast fashion 11. A new culture of exchange is becoming established	***Citizen transition to more responsible consumption***	-	Medium	Micro	Decreasing	This trend follows from social acceptance of the climate change goals. More responsible consumption and production (increasing resource efficiency and promoting sustainable lifestyles) should decrease energy demand in different sectors.
	12. Ethical and value-based financial services	***Ethical and value-based financial services***	-	Medium	Micro	Decreasing	Ethical banks lend or invest money to the projects with an ethical purpose, based not only on profit-related criteria, but

Cluster description	Initial trends	Selected trends (** = disruptive)	*Additional trends added by experts (related to initial trends / extra trends)	Impact degree (High / Medium / Low)	Impact scale (Macro / Meso / Micro)	Impact direction (Decreasing / Increasing / Shifting)	Additional context (narratives)
Priority clusters (top 10 selected by experts):							
							also on the social concerns. It may lead to further development of sustainability projects aimed at reducing energy consumption.
	13. Basic income	***Basic income***	-	High Medium	Micro	Increasing Decreasing Shifting	Changes in basic income would impact some low-income communities and will most probably raise their energy consumption but will also improve their living conditions. The main point is that they will do it in a more efficient way and probably shifting energy consumption from (inefficient) fossil fuels to electricity (see description in the cluster "Socioeconomic Equality").
	14. Dependence on natural resources	***Dependence on natural resources***	-	High	Micro	Increasing	The country's dependence on natural resources leads to less efficient consumption, which in general increases energy demand in different sectors.
	15. "Don't tread on me response to government policies	***"Don't tread on me" r esponse to government policies***	-	Low	Micro	Shifting Increasing	Protests and demonstrations against new green rules to save personal freedom and individualism in decision-making may lead to shifting or increasing energy consumption.

Cluster description	Initial trends	Selected trends (** = disruptive)	*Additional trends added by experts (related to initial trends / extra trends)	Impact degree (High / Medium / Low)	Impact scale (Macro / Meso / Micro)	Impact direction (Decreasing / Increasing / Shifting)	Additional context (narratives)
Priority clusters (top 10 selected by experts):							
*7. **Socio-economic Equality*** *Ensuring equality in providing basic needs (basic income, health coverage, etc.)* (8 initial trends) (5 votes) [group 3]	1. Unconditional minimum basic income	***Minimum basic income****	-	Medium	Micro	Increasing Decreasing Shifting	All these trends (1, 2 and 3) would impact some low-income communities and will most probably raise their energy consumption but will also improve their living conditions. The main point is that they will do it in a more efficient way and probably shifting energy consumption from (inefficient) fossil fuels to electricity. Basic income is the most disruptive trend: more money people have, more changes in how we consume.
	2. Basic Income		-	High	Micro	Increasing	
				Medium	Micro	Increasing Decreasing Shifting	
	3. National Referendum on unconditional basic income		-	Medium	Micro	Increasing Decreasing Shifting	
	4. Universal health coverage	***Universal health coverage****	-	High	Macro	Shifting	-
	5. Solidarity	-	-	-	-	-	-
	6. Social cohesion – the cement of 21st-century societies?	***Social cohesion – the cement of 21st century societies?***	-	High	Macro	Increasing Decreasing	This could both increase and decrease energy demand, depending on the development of the society.
	7. Privatisation of public services	***Privatisation of public services***	-	Medium	Meso	Increasing Decreasing Shifting	Public authorities tend to be more aware to environmental issues. The private sector will only fulfill the law or the most profitable. Depending on the service it would be an increase, a reduction or a shift of energy.

Cluster description	Initial trends	Selected trends (** = disruptive)	*Additional trends added by experts (related to initial trends / extra trends)	Impact degree (High / Medium / Low)	Impact scale (Macro / Meso / Micro)	Impact direction (Decreasing / Increasing / Shifting)	Additional context (narratives)
Priority clusters (top 10 selected by experts):							
							The main point for the privatisation of public services is that they will do it in a more efficient way and probably shifting energy consumption from (inefficient) fossil fuels to electricity.
	8. The gender pay gap	-	-	-	-	-	-
8. Energy Poverty *Energy poverty and inequalities caused by rising energy prices* (6 initial trends) (5 votes) [group 5]	1. Personal footprint – more reasonable consumption	-	-	-	-	-	-
	2. Rising energy prices	***Rising energy prices****	-	High Low	Meso	(Not assessed)	-
	3. New cities without the necessity of a car	***New cities without the necessity of a car***	-	Medium	Meso	(Not assessed)	-
	4. Car-free city	***Car-free city***	-	Medium	Meso	(Not assessed)	-
	5. Energy poverty	-	-	-	-	-	Energy efficiency should be one of the key parameters to shape the impact and maybe even resolve it. Energy efficiency drives the impact of this cluster. Impact depends on how energy efficiency measures are in place (like e.g. in mobility).
	6. Inequalities worsening	***Inequalities worsening****	-	Medium	Micro	(Not assessed)	Tradeoff: equality might increase energy demand. The impact depends on how measure to tackle poverty is designed in regard to energy demand.

Cluster description	Initial trends	Selected trends (** = disruptive)	*Additional trends added by experts (related to initial trends / extra trends)	Impact degree (High / Medium / Low)	Impact scale (Macro / Meso / Micro)	Impact direction (Decreasing / Increasing / Shifting)	Additional context (narratives)
Priority clusters (top 10 selected by experts):							
							Therefore, energy poverty as it impacts the share of energy cost on the total living costs, might motivate people towards more energy efficient lifestyles.
*9. **Water Issues*** *Increasing water scarcity effects multiple aspects of society* (17 initial trends) (4 votes) [group 1 + additional assessment by internal experts]	1. Increasing water scarcity 2. Food and water 3. Issuing water permits 4. Security of supply (EU)	***Global increase of water scarcity (supply security, water permits, etc.)****	-	High	Macro	Increasing Decreasing Shifting	Low-carbon technologies, if not properly managed, may exacerbate or be limited by water stress depending on the location, availability of water and competing users. Some low-carbon technologies, such as wind and solar PV, require very little water, others, such as biofuels, concentrating solar power (CSP), carbon capture, utilisation and storage or nuclear power, are relatively water-intensive.
	5. Migration and 'displacement 6. Migration 7. Climate refugees 8. Regional instabilities 9. Refugees from conflict or persecution	***Water- (and food-) related migration***	-	Medium	Macro Meso Micro	Increasing Decreasing Shifting	Water- (and food-) related migration can lead to increasing (in countries with high water availability), decreasing (in countries with low water availability) or shifting (in countries with medium water availability) energy consumption on different levels.

Cluster description	Initial trends	Selected trends (** = disruptive)	*Additional trends added by experts (related to initial trends / extra trends)	Impact degree (High / Medium / Low)	Impact scale (Macro / Meso / Micro)	Impact direction (Decreasing / Increasing / Shifting)	Additional context (narratives)
Priority clusters (top 10 selected by experts):							
	10. Localized food systems 11. Agricultural practices	***Rising water demand in agriculture****	-	High	Macro	Increasing	Rising water and energy demand in agriculture caused by food production for growing population (localised food systems, new agriculture technologies, etc.)
	12. Green electricity is needed, but increasing water scarcity (conflict) impacts energy supply 13. Green energy 'colonialism (EU) 14. Destabilised regions (electricity supply)	***Green electricity requiring more consumption of water resources****	-	High	Macro	Increasing	Green electricity requiring more consumption of water resources, which are already lacking (water footprint, green energy colonialism, etc.)
	15. Personal footprint – more responsible consumption	***Personal footprint – more responsible water consumption***	-	Medium	Micro	Decreasing	More responsible water and energy consumption may lead to decrease of energy demand.
	16. Emergence and growth of a global middle class	***Growing middle class modifying water consumption patterns***	-	High	Macro	Increasing	Demand for energy services has tended to rise especially fast in middle-income countries, where middle-class is rapidly growing.
	17. Diversification (EU)	***Diversification of water sources and technologies***	-	Low	Macro	Decreasing Increasing Shifting	Diversification of water sources and technologies may influence energy demand in different directions: decreasing (when less energy-intensive technology is introduced); increasing (when more technologies appear and

Cluster description	Initial trends	Selected trends (** = disruptive)	*Additional trends added by experts (related to initial trends / extra trends)	Impact degree (High / Medium / Low)	Impact scale (Macro / Meso / Micro)	Impact direction (Decreasing / Increasing / Shifting)	Additional context (narratives)
Priority clusters (top 10 selected by experts):							
							then more energy is required); shifting (when energy demand is shifting from the old to the new technology).
10. ***Healthy Aging*** *Increasing life expectancy and aging workforce in Global North due to advances in digital healthcare* (10 initial trends) (4 votes) [group 5]	1. Aging populations (Global North)	***Aging populations (Global North)****	-	(Not assessed)	(Not assessed)	(Not assessed)	The impact depends on the health status and the use of energy (e.g. digital devices) of the "aged" people – are they staying more at home and use more digital services? Other people can "afford more" and might be less prone to protect the environment (but at the same time using Tesla as a status symbol). Infrastructure: less mobility is needed in senior building complexes. Mobility, infrastructure, regional aspects shape the direction of impact. The impact can be found on the macro scale, but the degree of the impact depends on meso / micro level.
	2. Healthcare as related to the SDGs	***Healthcare as related to the SDGs****	-	Medium	Meso	Decreasing Shifting	Ideologically: influences more on macro scale. Practically: it probably depends more on micro level or even has impact on all the levels.

Cluster description	Initial trends	Selected trends (** = disruptive)	*Additional trends added by experts (related to initial trends / extra trends)	Impact degree (High / Medium / Low)	Impact scale (Macro / Meso / Micro)	Impact direction (Decreasing / Increasing / Shifting)	Additional context (narratives)
Priority clusters (top 10 selected by experts):							
							The equity issue "Global North vs. Global South" leads to shifting energy demand: maybe more from the private to the more centralised areas. Studies providing healthcare as the SDGs, suggest it should not lead to an increase but rather to a shift of energy demand.
	3. Growth of the global health market	***Growth of the global health market***	-	Medium	Meso	Increasing	Growth of the health market and digitalisation of services. Again, the impact shows more on macro scale, but the impact size depends more on meso level.
	4. Psychological Health	***Psychological health**** ***4.1. Psychological status (adaptability, flexibility to transitions etc.)*** ***4.2. Psychological health focus (more services, digitalisation of psychological services)***	-	Medium	Meso	(Not assessed)	-
	5. Aging Workforce	-	-	-	-	-	-
	6. Advances in digital healthcare	-	-	-	-	-	-

Cluster description	Initial trends	Selected trends (** = disruptive)	*Additional trends added by experts (related to initial trends / extra trends)	Impact degree (High / Medium / Low)	Impact scale (Macro / Meso / Micro)	Impact direction (Decreasing / Increasing / Shifting)	Additional context (narratives)
Priority clusters (top 10 selected by experts):							
	7. The battle against obesity is intensifying	-	-	-	-	-	-
	8. Increased 65+ age and increase in life expectancy	-	-	-	-	-	-
	9. New senior citizens are shaping protest culture	-	-	-	-	-	-
	10. Owing and sharing health data	-	-	-	-	-	-
Other 10 clusters:							
11. ***Urbanization*** Changing perceptions of inequalities caused by the rural and urban divide (18 initial trends) (3 votes) [group 5 +]	1. Increased urbanization	***Increased urbanization (rise of population and number of urban settlements)****	-	Medium	Macro Meso	Shifting	The general trends of increasing urbanisation, growing population size of urban settlements and the rise in the number of urban settlements are expected to shift the energy demand on meso level. Impacts is not 100% clear: it depends on the outline of the cities, distance to workplace, digitalisation, etc.
	2. Changes in rural and urban areas						
	3. Rise in the number of urban settlements						
	4. Population size of urban settlements						
	5. The growing importance of the region in the global economy	***Urban governance – solving global challenges locally in cities***	-	Low	Meso	Decreasing	In order to reduce energy use in cities, we need to locally manage the way energy flows into, through and out the city. Environmental legislation and governance issues are important for energy efficient cities (communication between
	6. Managing migration						

Cluster description	Initial trends	Selected trends (** = disruptive)	*Additional trends added by experts (related to initial trends / extra trends)	Impact degree (High / Medium / Low)	Impact scale (Macro / Meso / Micro)	Impact direction (Decreasing / Increasing / Shifting)	Additional context (narratives)
Priority clusters (top 10 selected by experts):							
							different stakeholders involved in the city).
	7. Localized food systems	***Localized food systems***	-	Low	Meso	Decreasing	Focussing on the local food supply will have a decreasing impact on the energy demand, and can counter anticipated increased energy demands from growing urban populations.
	8. Transportation systems	***Car-free cities and new transport models (hubs)****	-	High	Meso	Decreasing	Car-free cities may decrease impact on the energy demand and can counter anticipated increased energy demands from growing urban populations. Particularly, the car-free city can have a disruptive impact because land use changes enable other strategies for decreasing energy demand like greening urban areas and fostering localised food systems.
	9. New cities without the necessity of a car						
	10. Increased mobility						
	11. Fewer rural areas, more commuting, green urban planning, governing new urbanites	***Greening urban areas (including green urban planning, community gardening, etc.)***	-	Medium	Meso	Decreasing	Green Infrastructure elements (such as green roofs) may contribute to reducing primary energy consumption and therefore the GHG emissions associated with buildings: f.e. by reducing local temperature and shading building surfaces,
	12. Massive investment in green transition						
	13. Greening urban areas						

Cluster description	Initial trends	Selected trends (** = disruptive)	*Additional trends added by experts (related to initial trends / extra trends)	Impact degree (High / Medium / Low)	Impact scale (Macro / Meso / Micro)	Impact direction (Decreasing / Increasing / Shifting)	Additional context (narratives)
Priority clusters (top 10 selected by experts):							
	14. Community gardening						reducing the cooling demand for buildings.
	15. Urban-rural divide in US is also a political divide, policy and perception driven 16. Infrastructure builds out difficulties (US) 17. Skyscrapers and buildings that have potential for future ghettoisation (EU)	***Urban-rural divide and infrastructure difficulties***	-	Low	Macro	Increasing Decreasing Shifting	The energy consumption across cities follows common power law scaling increasing sub-linearly with their population regardless of their urban/rural classification. However, when considering per capita and sector specific consumptions, decreasing per capita consumption patterns are observed for growing population densities within more uniformly populated urban settlements.
	18. Citizen science (public participation in scientific research) – new challenges for science and society	***Citizen science (public participation in scientific research)***	-	Low	Meso	Decreasing	Public participation in scientific research related to green transition may raise awareness of people about sustainability problems and decrease their energy consumption.
12. ***Green Finance*** *Increasing recognition of behavioral impact leading to new financial services*	1. Financial system 2. Financing transition	***Green (sustainable) finance****	-	High	Macro	Decreasing Shifting	Financial system transition is a driver for everything to happen (a pre-requirement). It is going to be one of the main drivers to energy efficiency and electrification of services (shifting energy demand between fossil fuel to electricity

Cluster description	Initial trends	Selected trends (** = disruptive)	*Additional trends added by experts (related to initial trends / extra trends)	Impact degree (High / Medium / Low)	Impact scale (Macro / Meso / Micro)	Impact direction (Decreasing / Increasing / Shifting)	Additional context (narratives)
Priority clusters (top 10 selected by experts):							
(17 initial trends) (3 votes) [group 3]							in the transport and other sectors).
	3. Increasing recognition of climate risks among private sector actors (e.g. Task Force on Climate-related Financial Disclosures (TCFD))	***Increasing recognition of climate risks among private sector actors (e.g. Task Force on Climate-related Financial Disclosures (TCFD))****	-	Low	Micro	Decreasing Shifting	It should be one of the main drivers to energy efficiency and electrification of services (shifting energy demand between fossil fuel to electricity in the heating).
	4. Developing scenarios for the global financial system	-	-	-	-	-	-
	5. Emerging governance framework in the area of sustainable finance (EU, Asia, US)	-	-	-	-	-	-
	6. Ethical and value-based financial services	***Ethical and value-based financial services***		Low	Macro	Decreasing Shifting	The experts put a low impact because they hardly see the ethical finance to grow in any scenario (but they would hope to be wrong in this case).
				Medium	Macro	Decreasing	
	7. Pressure from society on financial services and businesses	-	-	-	-	-	-
	8. Crowdfunding is becoming established	***Crowdfunding is becoming established***	-	High	Micro	Decreasing	
				Medium	Meso	Decreasing	

Cluster description	Initial trends	Selected trends (** = disruptive)	*Additional trends added by experts (related to initial trends / extra trends)	Impact degree (High / Medium / Low)	Impact scale (Macro / Meso / Micro)	Impact direction (Decreasing / Increasing / Shifting)	Additional context (narratives)
Priority clusters (top 10 selected by experts):							
	as an alternative financing model	***as an alternative financing model***					
	9. Click to protest – more activities through organisation in the Internet?	-	-	-	-	-	-
	10. New senior citizens are shaping protest culture	-	-	-	-	-	-
	11. Citizen perceptions of environmental impacts of behaviors	***Citizen perceptions of environmental impacts of behaviors****	-	High Medium	Micro Micro	Decreasing Decreasing	Citizens say they want to be part of the transition but there are large barriers for them. One is the financial sector but others are political and also the biggest one, probably is the lack of trust in the institutions.
	12. Personal footprint – more responsible consumption	***Personal footprint – more responsible consumption***	-	High	Macro	Decreasing	-
	13. Giving up cash	***Green currencies***	-	High	Macro	Decreasing Increasing	-
	14. Alternative currencies						
	15. Digital currencies gaining in variety						
	16. Global crypto-currency markets						
	17. Divestment	***Divestment***		High	Micro	Decreasing	-
	1. Increase in population globally	***Growing youthful population (Global***	-	High	Macro	Increasing	Developing countries will be central, as 70% of the future

Cluster description	Initial trends	Selected trends (** = disruptive)	*Additional trends added by experts (related to initial trends / extra trends)	Impact degree (High / Medium / Low)	Impact scale (Macro / Meso / Micro)	Impact direction (Decreasing / Increasing / Shifting)	Additional context (narratives)
Priority clusters (top 10 selected by experts):							
13. ***Growing Youthful Population*** *Growing population in Global South requiring sustainable education, high Internet coverage and social innovation* (16 initial trends) (3 votes) [group 2 + additional assessment by internal experts]	2. The growing importance of the region in the global economy	***South) requiring high Internet coverage****					energy demand is expected to come from non-OECD countries in 2040, thanks to rapidly growing populations and economies.
	3. Concentrated youth populations (Global South)						
	4. Growing share of middle class in BRICS states						
	5. High Internet coverage						
	6. Shift of (geopolitical) power (East and South)	***Shift of (geopolitical) power: colonization, exploitation of Global South***	-	High	Macro	Increasing Shifting	Colonisation and exploitation of Global South leads to increased demand for energy (taking into account still unsustainable behavior patterns) and raises concerns over its impact on the environment.
	7. US historical relationship with parts of global South (CA/SA) – colonization, exploitation (how does this impact energy systems?)						
	8. Growing importance of enterprises in emerging economies	***Growing importance of enterprises in emerging economies***	-	Medium	Meso	Increasing	Growth in economic activity (measured as gross domestic product) tends historically to be coupled with increases in electricity use as populations grow and generate more goods and services.
	9. Economic activity in extreme climatic regions is being stepped up						

Cluster description	Initial trends	Selected trends (** = disruptive)	*Additional trends added by experts (related to initial trends / extra trends)	Impact degree (High / Medium / Low)	Impact scale (Macro / Meso / Micro)	Impact direction (Decreasing / Increasing / Shifting)	Additional context (narratives)
Priority clusters (top 10 selected by experts):							
	10. Citizen perceptions of environmental impacts of behaviors 11. Fridays for Future (EU) 12. Green ICT (case study) 13. Education and training options 14. Returns on state investment in education	***Sustainable education for growing youthful population****		Low	Meso	Decreasing	Sustainable education on meso level may encourage more sustainable behavior and therefore decrease overall energy consumption.
	15. Social disparities – fault lines of global development 16. Social innovations (EU)	***Social innovations (EU)***	-	Low	Micro	Decreasing	Social innovations for energy transition may include community energy systems and other initiatives. Local energy transitions may be different from global energy transitions due to the disproportionate importance of local actors and local-specific contexts.
*14. **Great Depression II*** *Depression affecting the financial situation in the countries and increasing migration*	1. Rising national debt in industrialised countries	***Rising national debt in industrialized countries****	-	High	Meso	Decreasing	Rising national debt may slow down the per-capita GDP growth (and therefore the energy demand) in industrialised countries through reduction of private saving, public investment, total factor productivity and long-term interest rates.

Cluster description	Initial trends	Selected trends (** = disruptive)	*Additional trends added by experts (related to initial trends / extra trends)	Impact degree (High / Medium / Low)	Impact scale (Macro / Meso / Micro)	Impact direction (Decreasing / Increasing / Shifting)	Additional context (narratives)
Priority clusters (top 10 selected by experts):							
(8 initial trends) (3 votes) [group 4 + additional assessment by internal experts]	2. Social disparities – fault lines of global development	***Social disparities – fault lines of global development***	-	-	-	-	-
	3. Migration and displacement						
	4. Managing migration						
	5. Increasing global migration	***Increasing global migration due to socio-economic problems (unemployment, etc.)****	-	Medium	Macro	Increasing Decreasing Shifting	Forced migration may increasingly serve as a mechanism through which unsustainable consumption patterns are transferred from the Global South to the Global North, which leads to general increase of energy demand in developed countries. At the same time, energy consumption in developing countries may decrease. In case of internal migration, energy demand may shift from one region to another / from one sector to another, etc.
	6. Migration for social mobility						
	7. Refugees from conflict or persecution						
	8. Climate refugees						
		ADDITIONAL TRENDS:	*Global COVID-19 crisis and collapse of health care systems	High	Macro	Decreasing	In general, although the overall energy demand declines, the spatial and temporal variations are complicated. The COVID-19 pandemic will have a dramatic impact on energy supply and demand in the short term and will have lasting impacts once

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Priority clusters (top 10 selected by experts):							
							the pandemic dissipates. However, that will in itself contribute little to advance the global progress towards the Paris climate ambitions.
			*Slowing economic growth in China, US and Europe	High	Macro	Decreasing	Slowing GDP growth and changing consumption patterns make significant contributions to emissions deceleration.
15. ***Rebound Effect*** *Policy consequences detract from efficacy due to adaptation (market, consumer etc.)* (15 initial trends) (3 votes) [group 4]	1. Social innovations (EU)	***Social innovations (EU)****	-	High	Macro Micro	Decreasing	Social innovations: including many different technologies/trends.
	2. Citizen science – new challenges for science and society	***Citizen science – new challenges for science and society****	-	High	Macro	Increasing Decreasing Shifting	Citizen science: different technologies (e.g. EV usage, heat pumps, hydrogen) might have a disruptive influence.
	3. Building markets for sustainable products (EU)	***Building markets for sustainable products (EU)***	-	Low	Macro	Decreasing	-
	4. CEAP (EU)	***CEAP (EU)****	-	Medium	Macro	Increasing	Circular Economy Action Plan (CEAP): circular economy could have a disruptive influence but not necessarily. It is important how the plan itself has been implemented.
	5. Fossil fuel and industrial power resistance (US based companies)	***Fossil fuel and industrial power resistance (US based companies)***	-	Low	Macro Meso	Increasing	-

Cluster description	Initial trends	Selected trends (** = disruptive)	*Additional trends added by experts (related to initial trends / extra trends)	Impact degree (High / Medium / Low)	Impact scale (Macro / Meso / Micro)	Impact direction (Decreasing / Increasing / Shifting)	Additional context (narratives)
Priority clusters (top 10 selected by experts):							
	6. Rebound effect: underestimated paradox of sustainability policy	***Rebound effect: underestimated paradox of sustainability policy***	-	Low	Meso	Increasing	Direct rebound effect: underestimated paradox of sustainability policy.
				Medium	Meso	Increasing	Macroeconomic rebound effect: underestimated paradox of sustainability policy
	7. Policy and behavior (e.g. buying 5 max efficiency TVs is not helping), restrictive policies	***Policy and behavior (e.g. buying 5 max efficiency TVs is not helping), restrictive policies***	-	Medium	Meso	Decreasing	-
	8. Challenging established and traditional gatekeeper powers (resistance)	***Challenging established and traditional gatekeeper powers (resistance)***	-	Medium	Meso	Decreasing	-
	9. Slow consumption as a countertrend to fast fashion	***Slow consumption as a countertrend to fast fashion****	-	High	Meso	Decreasing	Slow consumption can be implemented not only in fashion industry but also in other areas, taking into account current COVID-19 situation.
	10. New requirements for material flows for consumer goods have a delayed impact on the environment and disposal systems	***New requirements for material flows for consumer goods have a delayed impact on the environment and disposal systems***	-	Low Medium	Macro	(Not assessed)	-
	11. Citizen perceptions of environmental impacts of behaviors	***Citizen perceptions of environmental impacts of behaviors***	-	High	Meso	Decreasing	Citizen positive perceptions of impacts of behaviors.
				High	Meso	Increasing	Citizen negative perceptions of impacts of behaviors.

Cluster description	Initial trends	Selected trends (** = disruptive)	*Additional trends added by experts (related to initial trends / extra trends)	Impact degree (High / Medium / Low)	Impact scale (Macro / Meso / Micro)	Impact direction (Decreasing / Increasing / Shifting)	Additional context (narratives)
Priority clusters (top 10 selected by experts):							
	12. Behavior of people, activities perceived as green increase	***Behavior of people, activities perceived as green increase***	-	High	Meso	Decreasing	Behavior of people, activities perceived as green increase.
	13. Unsustainable consumer patterns	***Unsustainable consumer patterns***	-	High	Meso Micro	Increasing	-
	14. A new culture of exchange is circular economy demands more transportation	***A new culture of exchange is circular economy demands more transportation***	-	Low	Micro	Increasing	-
	15. Education and training options	***Education and training options***	-	Medium	Macro Meso	Decreasing	-
*16. **Geopolitics and Global Forces*** *Role of the geopolitical dimension in trade, social aspects, demand/supply sides* (12 initial trends) (2 votes) [group 2]	1. Relation (Global North & South)	***Relation (Global North & South)****	-	Low	Macro	Shifting	-
	2. Growing share of middle class in BRICS states	***Growing share of middle class in BRICS states****	-	High	Macro	Increasing	-
	3. African innovations point to new paths for innovations	***African innovations point to new paths for innovations***	-	Medium	Macro	Increasing	The impact will be increasing energy demand assuming it unlocks new economic activity.
	4. The geopolitical dimension	-	-	-	-	-	-
	5. Shift of (geopolitical) power (East and South)	***Shift of (geopolitical) power (East and South)***	-	Low	Meso	Shifting	-
	6. US/China technological confrontation	***US/China technological confrontation****	-	Low	Macro	Shifting	-

Cluster description	Initial trends	Selected trends (** = disruptive)	*Additional trends added by experts (related to initial trends / extra trends)	Impact degree (High / Medium / Low)	Impact scale (Macro / Meso / Micro)	Impact direction (Decreasing / Increasing / Shifting)	Additional context (narratives)
Priority clusters (top 10 selected by experts):							
	7. Reliance on non-EU suppliers	***Reliance on non-EU suppliers***	-	Medium	Meso	Decreasing	-
	8. Strong trade and investments	***Strong trade and investments***	-	High	Macro	Increasing	-
	9. Increase in population globally	***Increase in population globally***	-	High	Macro	Increasing	-
	10. Social disparities – fault lines of global development	***Social disparities – fault lines of global development***		Medium	Macro	Shifting	-
	11. Inequalities worsening	***Inequalities worsening***	-	Medium	Macro	Increasing	-
	12. Climate change: 36% CO_2 increase by 2035 (without counter-measures)	***Climate change: 36% CO_2 increase by 2035 (without counter-measures)***	-	High	Macro	Increasing	-
*17. **New Labour*** *Increasing relevance of labor for societal participation* (13 initial trends) (1 vote) [group 4 + additional assessment by internal experts]	1. Labor markets and job losses	***Rise of global unemployment due to COVID-19 pandemic****	-	High	Macro	Decreasing	Massive job losses in different countries may cause decrease of consumption worldwide.
	2. Unconditional minimum basic income						
	3. Populism & Nationalism	***Populism & Nationalism, loss of trust in government***	-	Low	Meso	Increasing Shifting	Loss of trust in government may lead to unsustainable consumption in the European countries.
	4. Partly skepticism on the usefulness of the EU						
	5. Loss of trust in government						
	6. Increasing global migration	***Increased working migration****	-	Medium	Meso	Increasing Decreasing Shifting	Increased working migration may influence energy demand in different directions: increasing (in receiving regions), decreasing
	7. Increased migration to the cities						

Cluster description	Initial trends	Selected trends (** = disruptive)	*Additional trends added by experts (related to initial trends / extra trends)	Impact degree (High / Medium / Low)	Impact scale (Macro / Meso / Micro)	Impact direction (Decreasing / Increasing / Shifting)	Additional context (narratives)
Priority clusters (top 10 selected by experts):							
	8. Managing migration						(in sending regions) or shifting (within one region).
	9. Inequalities worsening	***Inequalities worsening (gender pay gap, etc.)***	-	Low	Meso	Decreasing	Gender differences do matter for energy poverty in the Global North. Worsening such inequalities may lead to decreasing energy consumption.
	10. Education and training options	***New educational models (digital) and importance of digital literacy and skills****	-	Medium	Macro	Decreasing	Online learning can play a role in reducing the ecological footprint of higher education (classroom space, energy, course materials, transportation to campus). Students will still consume energy when they take courses at home, but it takes far less to power existing structures (like home offices) than it does to power a large, external facility.
	11. Reinventing education						
	12. Digital literacy and skills						
	13. Digital competency pressure as a social organisational ta sk						
*18. **Migration and Displacement***	1. Increasing global migration	***Increasing global migration****	-	High Medium	Macro	Increasing	Migration and displacement trends are not disruptive; they will be developing unless we consider secondary effects (shift in a political crisis).
Increasing global migration which requires fair access to water and modern energy services	2. The growing importance of the region in the global economy	***The growing importance of the region in the global economy****	-	Low	Meso	Increasing	Growing regionalization is possible under COVID-19 conditions. But the experts do not expect This trend to have a major impact on energy demand in long-term perspective.

Cluster description	Initial trends	Selected trends (** = disruptive)	*Additional trends added by experts (related to initial trends / extra trends)	Impact degree (High / Medium / Low)	Impact scale (Macro / Meso / Micro)	Impact direction (Decreasing / Increasing / Shifting)	Additional context (narratives)
Priority clusters (top 10 selected by experts):							
(8 initial trends) (1 vote) [group 2]	3. Migration for social mobility	***Migration for social mobility***	-	Medium	Meso	Increasing	During social mobility migrants achieve an improved socioeconomic position through increased economic opportunities, or experience downwards mobility as a result of not being able to transfer their economic, social or educational resources to the receiving country context.
	4. Migration for work and opportunities	***Migration for work and opportunities***	-	Medium	Meso	Increasing Decreasing	Migrating from poor infrastructure to infrastructure with high specific energy demand, minority might improve on specific energy consumption by moving into better infrastructure.
	5. Climate refugees	***Climate refugees***		Medium	Meso	Increasing	-
	6. Increasing water scarcity	***Increasing water scarcity***	-	High	Macro	Increasing	-
	7. Refugees from conflict or persecution	***Refugees from conflict or persecution***	-	Medium	Meso	Increasing	-
	8. Solidarity	***Solidarity***	-	Low	Micro	Decreasing	Solidarity needs to be defined and can be seen as follows: current young generation (0 to 20+) is learning different types of communication and solidarity aspects – which could have great impact on many fields like energy consumption.

Cluster description	Initial trends	Selected trends (** = disruptive)	*Additional trends added by experts (related to initial trends / extra trends)	Impact degree (High / Medium / Low)	Impact scale (Macro / Meso / Micro)	Impact direction (Decreasing / Increasing / Shifting)	Additional context (narratives)
Priority clusters (top 10 selected by experts):							
19. ***Growing Middle Class*** *Growing urban middle class potentially contributing to sustainable urban development* (6 initial trends) (1 vote) [group 2]	1. Emergence and growth of a global middle class	***Emergence and growth of a global middle class****	-	High	Macro	Increasing	-
	2. Growing share of middle class in BRICS states	***Growing share of middle class in BRICS states***	-	High	Macro	Increasing	-
	3. The global urban middle class – tipping the scales of sustainable urban development?	-	-	-	-	-	-
	4. Unsustainable consumer patterns	***Unsustainable consumer patterns****	-	High	Micro	Increasing	Potentially disruptive: hard to predict the potential for consumers to "overindulge" once new consumption option is available – e.g. unpredicted explosion of demand for Uber, Airbnb, e-scooters, etc.
	5. Increasing land area of cities	***Increasing land area of cities***	-	Medium	Micro	Increasing	Impact may be notable on micro level because cities provide more energy consumption opportunities, but energy saving mobility options should be also taken into account.
	6. Rise in the number of urban settlements	***Rise in the number of urban settlements***	-	Medium	Meso	Increasing	-
20. ***Evolving Democratic System***	1. EU regulatory power	***EU regulatory power***	-	High	Macro	Decreasing	-
	2. Governance policies	-	-	-	-	-	-
	3. Increased EU integration	-	-	-	-	-	-

Cluster description	Initial trends	Selected trends (** = disruptive)	*Additional trends added by experts (related to initial trends / extra trends)	Impact degree (High / Medium / Low)	Impact scale (Macro / Meso / Micro)	Impact direction (Decreasing / Increasing / Shifting)	Additional context (narratives)
Priority clusters (top 10 selected by experts):							
Political systems adapting to social platforms, data streams, changing demographics (13 initial trends) (0 votes) [group 3]	4. Loss of trust in government	***Loss of trust in government****	-	Medium	Meso	Increasing	This will not trigger investments, so people will not reduce their energy consumption as much as needed.
	5. Challenging established and traditional gatekeeper powers (resistance)	-	-	-	-	-	-
	6. Loss of trust in media	***Loss of trust in media***	-	Medium	Meso	Increasing	-
	7. Populism & Nationalism	***Populism & Nationalism****	-	High	Macro	Increasing	-
	8. Right-wing populism and the denial of equal rights	***Right-wing populism and the denial of equal rights***	-	High	Macro	Increasing	-
	9. Rising global burden of disease	***Rising global burden of disease****	-	High	Macro	Increasing	Aging population trend has important impact on rising global burden of disease. This is a complex issue as people are going to spend more energy at home but they are going to travel and expend a lot less (so less energy consumption there). Then people will need more cares and this would impact our health system, but not going to be too much important from an energy point of view.
	10. Managing migration	-	-	-	-	-	-

Cluster description	Initial trends	Selected trends (** = disruptive)	*Additional trends added by experts (related to initial trends / extra trends)	Impact degree (High / Medium / Low)	Impact scale (Macro / Meso / Micro)	Impact direction (Decreasing / Increasing / Shifting)	Additional context (narratives)
Priority clusters (top 10 selected by experts):							
	11. Massive investment in green transition	***Massive investment in green transition***	-	High	Macro	Decreasing	-
	12. Citizen participation	***Citizen participation***	-	Medium	Meso	Decreasing	-
	13. Click to protest – more activities through organisation i n the internet?	-	-	-	-	-	-

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